Efficacy of Five Organic Acids Combination on T2- Mycotoxicosis in Rats

Ammar A. Fadhil[1], Suhair Hassan Alkutbi[2], Eman S. Nassir[2] Msc.

[1]*Tutor, Department of Pharmacology & Toxicology,* [2]*Tutor, Department of Clinical Laboratory Sciences, College of Pharmacy-University of Baghdad-Baghdad, Iraq*

Abstract

Mycotoxins are secondary by-products of mold metabolism and are accountable for human and animal mycotoxicosis. The most serious trichothecenic mycotoxin is the fungal T-2 mycotoxin. T-2 mycotoxin impaired nutrient absorption, metabolism, and then, eliciting severe oxidoreductive stress. Diet plays a key role beyond the supply of nutrients in order to promote animal and human health. Organic acids have been commonly used to exert antioxidative stress capacity in the liver and gut ecosystem. This study is planned to explore, the competence of using (X-MoldCid®) during chronic T-2 mycotoxicosis course in rat. Rats were allocated into 4 main groups, (CN-Gr), negative control and was allowed for the free access to the normal rats chow and the tap water for 90 days. (OAC-Gr), which was assigned as the organic acids positive control and was allowed for the free access to normal rat chow and (X-MoldCid®) in the tap water for 90 days .Group 3 or (T2-Gr) and was given the T2 contaminated chow ad libitum and group 4 (T2+OAC-Gr) .Each one of the four groups was subdivided into two subgroups (n=7) that one was sacrificed on day 45 (Subgroup A) meantime the remaining rats (Subgroup B) maintained until finishing of the entire study period (90 days). In T2 intoxicated group, liver histopathological findings revealed, lesions of reversible types (hydropic and fatty degenerations) while intestinal histopathological findings revealed, lesions of hyperactive goblet cells with sever slaughing of epithelia. In T2+OAC-Gr, the ultimate efficacy of organic acids success in limiting the apoptotic activity and preventing hepatic necroinflammatory changes which were in accordance with the improvement of antioxidative status, liver and intestinal function enzymes and other serum biochemical estimated tests. The total results of this study have been clarified the regenerative and antioxidant potentials of (X-MoldCid®) in coping with T2-toxin mediated intestinal lesions and hepatotoxicityin rats.

Keywords: *Histopathological lesions, Hepatoxicity, Oxidoreductive stress, T-2 mycotoxin, X-MoldCid®* .

Introduction

Mycotoxins are a toxic metabolites introduced though various cast varieties forms usual microflora of agricultural crops and products. Usually this results when toxin-producing fungi grow in crops and feed mostly in climates with extremely temperature and humidity]1[. A one fungal varieties and two more fungal varieties may introduce two mycotoxin [2,3[. Today, four hundred mycotoxins or more will be found but the most studied are trichothecenes (T-2 toxin and HT-2, toxin deoxynivalenol]4[.Trichothecene family presents of enormous range of toxins, like T2 the first to achieve it amidst many toxic elements of the groups as resemble many mycotoxins and their metabolites influence the gastrointestinal order, skin, liver[5]. T2 toxin is essentially existed in crops grains, like barley, maize, wheat, and chiefly in oats]6,7[. In domestic animals, the sensitive for this kind toxin varying from animals, and top sensitive being, reproductive, immunological [8 [. In rats, subchronic or chronic influences is seen in uncover to T-2 toxin in dosages from 0.3 mg/kg bulk**, t**hat includes

Corresponding author:
Ammar A. Fadhil MSc.
Pharmacology Department & Toxicology-College of Pharmacy, Baghdad University, Baghdad, Iraq
Email: pic.manager.iraq@gmail.com

variety blood parameters and damages in the esophageal parts [9]. In 2007, 2013 the researchers findings, that T-2 toxin, could be cytotoxic to cells divided and could stop protein and DNA forming, causes apoptosis and necrosis [10,11[. On the other hand, when chickens fed by nutrients include T-2 toxin, cytomorphosis and a big distance of necrosis happened in proliferative range in the epiphyseal piece]12[.Organic acids are type of short-chain fatty acid, most of which was used for tenths of years to maintain nutrients and obstacle the growth of microbes (fungi and bacteria)]13,14[. The mechanism of action of organic acids on mycotoxin type T2 based by the activation of growth and immunity indirectly, whether by eliminating the fungi inside the food and body and not provide a suitable center for its activity]15- 17[. The use of organic acids has great influence on the act of broiler chicken [18[, support of food benefit and breed and feed transform complement]19[. People in world need healthy and nutritious poultry products free of innate toxins with **o**rganic acids provide that [20-22]. Organic acids supplementation is informed to lowering colonization of pathogens and making of toxic metabolites] 23[. Organic acids are existed widely tissues of animals and vegetables [24[. It was informed that propionic, formic, citric, lactic and ascorbic acids grew foods digestibility without damaging influence]25[. The organic acids (X-MoldCid®) are contains (Acetic acids E260., Propionic acid E280., Formatic acid E236., Phosphoric acid E238., and Lactic acid E270 produced by XVET® farm, Germany company reduce mold and bacteria growth also promotes poultry gut health. Therefore; this study shall shed light on dark areas of the effectiveness of organic acids against T2-mycotoxicosis in rats.

Materials & Methods

Materials

The T2 contaminated diet was obtained from Scientific Laboratories of Beetar Sun Co Ltd. (The Group) Company, Baghdad-Iraq. A T2 contaminated diet level of (470 ppb) was determined by (Veratox® brand of diagnostics from Neogen® which are quantitative microwell enzyme-linked immunosorbent assay (ELISA) exams). The organic acids (X-MoldCid®) are contains (Acetic acids E260., Propionic acid E280., Formatic acid E236., Phosphoric acid E238., and Lactic acid E270 produced by XVET® farm Germany.

Chemicals

The elements used were of class quality and were manufactured by Sigma-Aldrich. Exclusively, all the working solutions were formulated using deionized water. SOD, CAT, and GSH-PX test sets were obtained by Nanjing Key Gen Biotech. Co. Ltd. (Nanjing, China). Concurrently, ALT, AST and ALP enzymes assay kits are purchased from (Bio-Merieux Laboratory Reagents and productions, France).

Animals

Male rats (n=56) of Wister strain (150-165g) were obtained from the Animal House, College of Pharmacy, University of Baghdad. The animals were allowed to acclimatize for 2 weeks in under controlled conditions (21±2^{C}, with a 55%±5% humidity and a 12h light/12h dark.

Treatments

Fifty six males randomly divided into four main groups (n=14), viz; the negative control or (CN-Gr), which was fed usual nutrition and water *Ad libitum* for ninety days. The positive control or (OAC-Gr), which assigned as the organic acids (X-MoldCid®) and was allowed for the free access to normal rat chow and (X-MoldCid®) in the tap water (6ml/rat every 5 days) for 90 days,(T2-Gr) was given the T-2 contaminated diet ad libitum at a level of (470 ppb) along with normal drinking water for 90 days and (T2+OAC-Gr) which was given the T2 contaminated rodent's chow ad libitum at a level of (470 ppb) along with organic acids (X-MoldCid®) in the tap water (6ml/rat every 5 days) for 90 days. Each one of the four groups was subdivided into two subgroups (n=7) that one was sacrificed on day 45 (Subgroup A) meantime, the remaining male rats (Subgroup B) were kept until the complete of the research time (90 days). Blood and tissues collections were twice done at the complete of (45th and 90th day) of the experimental periods.

Serum Biochemical Analyses

The serum protein level measured by using Bradford reaction method (Bradford, 1976) [26], while the liver working exams ALP, AST and ALT works are detected using the trade sets obtained from (Bio-Merieux Laboratory Reagents and Products, France).

Measurement of Oxidative/Antioxidative Stress Parameters.

Measurement of Oxidative/antioxidative stress markers (TOC and TAC) were done according to (Erel, 2004) (Erel, 2005) [27, 28] and the commercial kits obtained by (Rel Assay Diagnostics®, Gaziantep, Turkey). Meanwhile, the oxidative stress index (OSI) was measured through dividing the total oxidant capacity (TOC) to the total antioxidant capacity (TAC). The serum level of malondialdehyde (MDA**)** is defined by the way stated by Kikugawa et al., 1992 [29]. It was expressed in nmol/ml. Furthermore, the reduced form of the glutathione(r-GSH) was measured in the RBCs hemolysate using the method described by Ellman in (1959) [30] and [31]. On the other hand, the serum activities of glutathione peroxidase (GSH-Px), catalase (CAT) and the superoxide dismutase (SOD) are analyzed as per the spectrophotometric method described by the Randox diagnostic's Kits [32].

Histological evaluation of body organs

After the end of treatment, the euthanized animals were morally slaughtered by cervical separation. Organs were dissected out: livers and small intestines then affixed in 10% neutral buffered formalin saline for histological examination [33 [.

Analyzing of Statistics

They Includes The Mean Analytical variable ± SE of the mean (SEM) then, One-way ANOVA and the Least Significant Difference (LDS,s) followed by post hoc Branferroni test. All these tests are done using the SPSS part 18 statistical package, 2010, (SPSS Inc. Chicago, IL, USA). P- Value of less than 0.05 is recognized important outcomes.

Findings

Liver function tests

Liver function tests revealed the absence of any important variance in the serum level of the hepatic enzymes between (CN-Gr) and (OAC-Gr) ($P<0.05$)) Table 1). Meanwhile, the deterioration in the hepatic functions was obvious and significantly different in comparison to that of the negative control for the T2 treated groups (T2 and T2+OAC groups) on days45and 90 ($P<0.05$) (Table 1) that it was stronger on day 90 as compared to that on day 45 (Table 1). It worth to note that co treatment with the OAC has significantly ameliorated the hepatic dysfunction in the T2+OAC treated group as seen in the results of the AST and ALT levels (Table1)**.**

Table-1: Hepatic enzymes (Alkaline Phosphatase (ALP), Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) tests in serum of rats of all groups at day 45 and 90 of the experimental study.(The data are expressed as mean ± SEM).

Groups	ALP (IU/L)		AST (IU/L)		ALT (IU/L)	
	45 Days N=7	90 Days N=7	45Days N=7	90 Days N=7	45 Days N=7	90 Days N=7
CN-Gr	119.66±4.53A	120.14±4.44A	125.15±2.96A	127.33±3.33A	28.44±1.90A	30.35 ±1.84A
OAC-Gr	118.33±2.35A	118.24±2.10A	124.22±3.50A	125.50±2.85A	28.58±1.04A	29.30±1.35A
T2-Gr	140.18±3.93B	318.15±7.88B	140.23±2.55B	277.43±7.22B	38.93±1.56B	98.34±3.77B
T2+OAC-Gr	137.11±2.92B	315.45±6.20B	138.25±2.81B	165.71±3.45C	29.18±2.18A	55.20±1.90C

(CN-Gr) =negative control group, (OAC-Gr) = Organic acids treated group, (T2-Gr) = T-2 intoxicated group and (T2+OAC-Gr) = T-2 intoxicated group+ Organic acids treated groups respectively.

(Each value that is not sharing a common superscript letter signifies a important variety difference with *P<0.05*).

The sample size is 7 rats for each group.

Levels and Activities of Oxidative Stress and Antioxidant Biomarkers

Serum MDA and TOC concentrations are important ($p < 0.05$) higher, and TAC and OSI concentrations are reduced ($p < 0.05$) in rats intoxicated in T2 than in nonintoxicated ones. Additionally, we observed significantly higher ($p < 0.05$) TAC and OSI concentrations in T2+OAC-Gr that post treated with OAC compared with T2-GR. Meanwhile, post manipulating OAC did not produce that much change in the OAC-Gr as compared to that of the CN-Gr. but it hindered the T2 induced deterioration in the oxidative stress as seen in the results of the T2+OAC-Gr (Table 2&3). The OAC induced decline was still variety bigger than that of the control for the serum levels of MDA, TOC and OSI but the decline was comparable and insignificantly different to that of the negative control for the TAC values ($P<0.05$) (Table 3). Similarly, post treatment of the OAC to the intoxicated rats produced a decline in the serum level of the antioxidant enzymes and the hemolysate level of glutathione that was significantly less than that of the OAC untreated T2 rats and stayed bigger from control negative ($P<0.05$) (Table 3).

Table 2:- Biochemical measurements of Serum Malondialdehyde (MDA), Total Antioxidative Stress ability (TAC), Whole Oxidant Capacity (TOC) and Oxidative Stress Index (OSI) for all groups at day 45 and 90 of the experimental study. (The results are expressed as mean ± SEM)

	At 45day (n=7)				At 90 day (n=7)			
	MDAnmol/ml.	TOC (μmol H2O2Eq/L)	TAC (TroloxEqμmol/L)	OSI (TOC/TAC) (arbitrary unit)	MDAnmol/ml.	TOC (μmol H2O2Eq/L)	TAC (TroloxEqμmol/L)	OSI (TOC\TAC) (arbitrary unit)
CN-Gr	18.54±1.11A	13.3±3.52A	1.61±0.27A	0.12±0.81A	19.85±1.30A	14.8±3.68A	1.45±0.21A	0.10±0.75A
OAC-Gr	17.99±1.40A	12.5±2.70A	1.92±0.45B	0.15±0.65B	19.50±1.55A	15.5±2.95A	1.36±0.52B	0.08±0.66B
T2-Gr	26.35±2.35B	19.5±3.64B	0.99±0.64C	0.05±0.02C	38.39±2.17B	23.4±3.55B	0.86±0.22C	0.04±0.95C
T2+OAC-Gr	22.14±1.58C	12.4±4.15A	1.51±0.97A	0.12±0.76A	24.27±1.25C	19.3±3.06C	1.48±0.20A	0.08±0.84B

(CN-Gr) =negative control group, (OAC-Gr) = Organic acids treated group, (T2-Gr) = T-2 intoxicated group and (T2+OAC-Gr) = T-2 intoxicated group+ Organic acids treated groups respectively.

(Each value that is not sharing a common superscript letter signifies a important in statistics variance wit**h** *P<0.05*).

The sample size is 7 rats for each group.

Table 3: Serum activities of Glutathione peroxidase (GSH-Px), Super oxide dismutase (SOD) with Catalase (CAT)) antioxidative stress enzymes together with the RBCs hemolysate reduced glutathione (r-GSH) concentrations at days 45 and 90 of the experimental period. (The results showed as mean ± SEM).

GROUP	At 45 day				At 90 day			
	r-GSH (μmol/m)	GSH-Px (U/ml)	SOD (U/ml)	CAT (U/ml)	r-GSH (μmol/m)	GSH-Px (U/ml)	SOD (U/ml)	CAT (U/ml)
CN-Gr	22.07±1.11A	113.4±5.7A	84.54±2.5A	2.99±0.13A	21.05±1.15A	116.5±5.2A	88.83± 2.66A	2.95± 0.16A
OAC-Gr	22.10±1.12A	114.5±6.3A	83.22±2.8A	3.05±0.13A	22.15±1.18A	118.4±5.2A	87.13± 2.13A	3.07± 0.15A
T2-Gr	20.98±1.07A	109.9±4.5B	65.85±1.5B	2.15±0.18B	12.24±1.08B	74.9±5.3B	48.33± 2.11B	1.11± 0.17B
T2+OAC-Gr	21.15±1.73A	114.5±3.5A	75.64±2.4C	2.18±0.13B	16.77±1.01C	103.9±3.8C	68.45± 2.20C	2.11± 0.10C

(CN-Gr) =negative control group, (OAC-Gr) = Organic acids treated group, (T2-Gr) = T-2 intoxicated group and (T2+OAC-Gr) = T-2 intoxicated group+ Organic acids treated groups respectively. r-GSH, GSH-Px, SOD and CAT refer to the blood hemolysate reduced glutathione level, serum level of the glutathione peroxidase, superoxide dismutase and catalase respectively.

(Each value that is not sharing a common superscript letter signifies a important varies *P<0.05*).

The volume is 7 rats for each group.

Liver Histopathological findings

The microscopical histopathological samples of liver & intestine obtained from control group revels normal architecture (fig 1 ,2) while in T2 intoxicated group , the 2 organs show different histopathological lesions, theT-2 mycotoxin cause a moderate to severe alteration in liver parenchyma characterized by degenerative changes ,hydropic degeneration(accumulation of water droplet inside hepatocytes give it ground glass appearance) & fatty infiltration (presence of rounded droplet of fat inside the cytoplasm) ,these lesion recorded in different lobular segment especially the hepatic centrilobular area ,fig (3),in less distance the hepatic centri lobular lobe show also micro nodular necrosis with infiltration of inflammatory cells usually mono nuclear cells fig (3) . The histopathological findings of intestinal segment from T2 treated group shows catarrhal changes characterized by goblet cells hyperplasia and it appear hyper active, fusion & desquamation necrosis of villous epithelial cells with congestion of blood vessel. Also there is an infiltrationof mono nuclear cells in lamina propria of mucosal layer of the intestinal wall. Fig 4 after 45 days from the onset of experiment , the group fed with (T2+OAC) , show restricted histopathological changes comparing with those of T2 intoxicated one, in liver the hepatic cords usually restore its normal architecture, mild congestion with less lesion. Fig 5 also the intestinal segment revels the role of organic acid in limiting the lesion with less toxic effect fig 6.

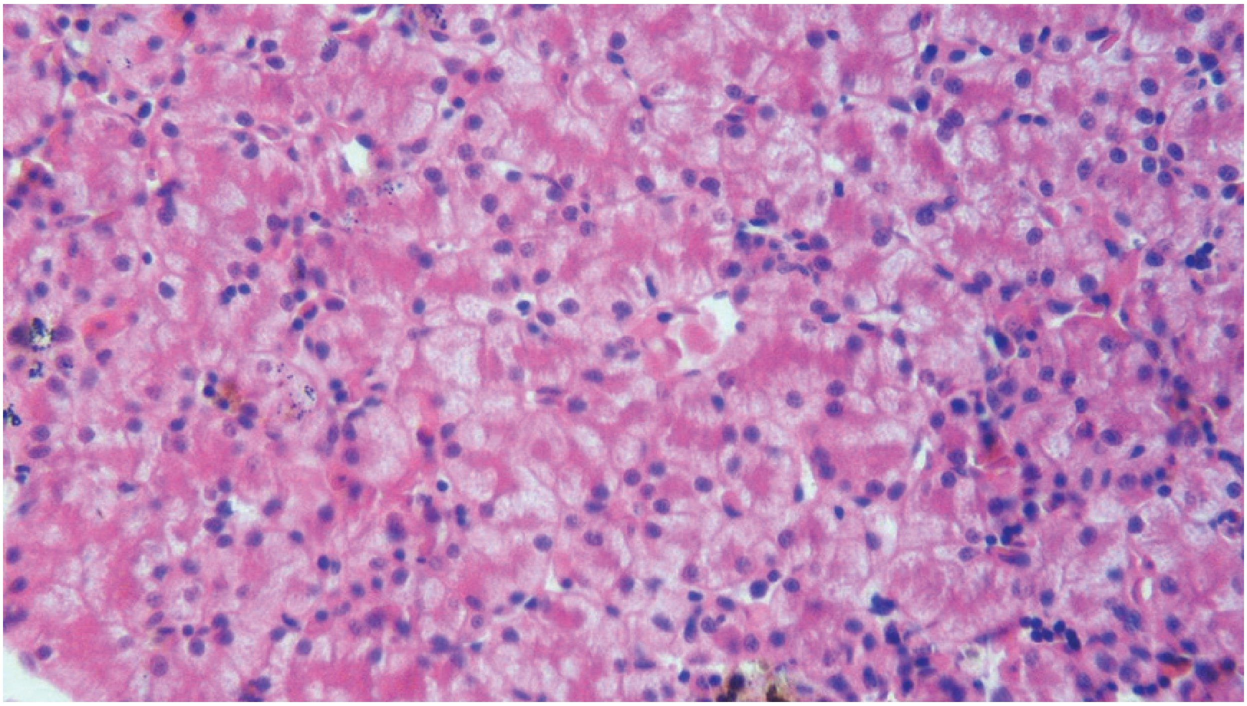

Figure 1: Histopathological section of liver from control group show normal architecture with no evidence of any changes (H&E) (X20)

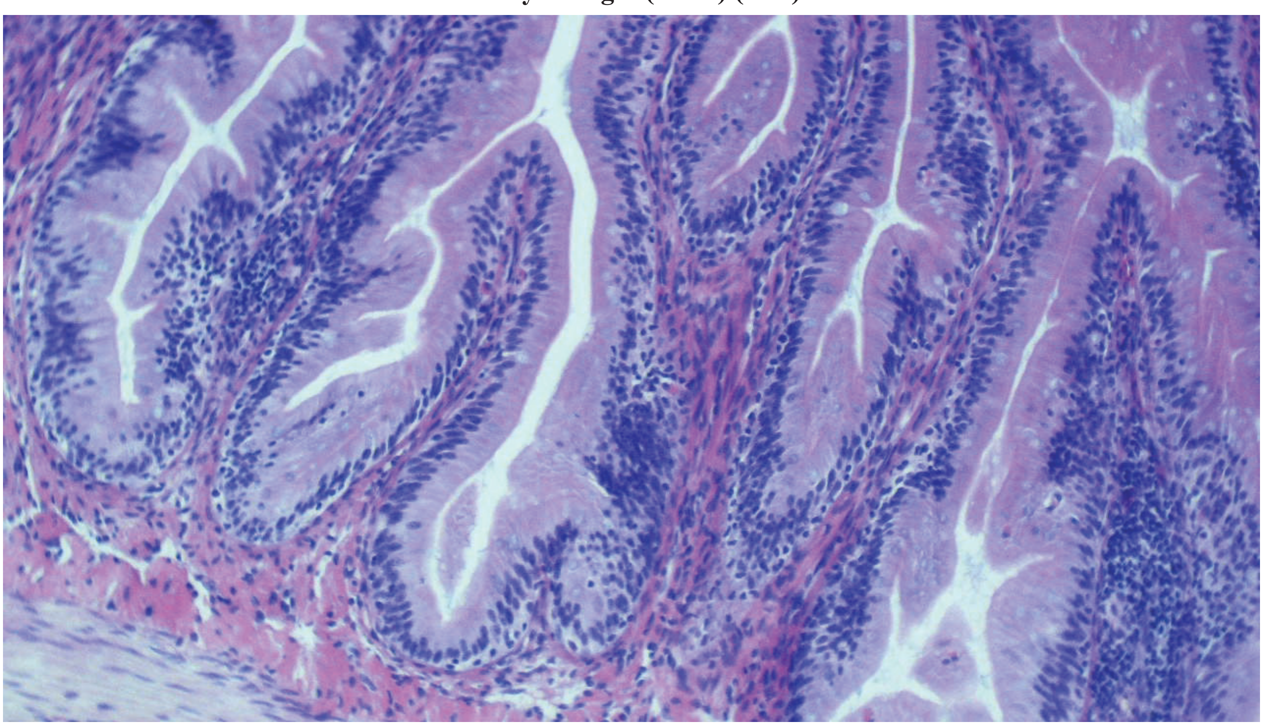

Figure 2: Histopathological section in small intestine from control group with normal criteria & no obvious changes (H&E) (x20)

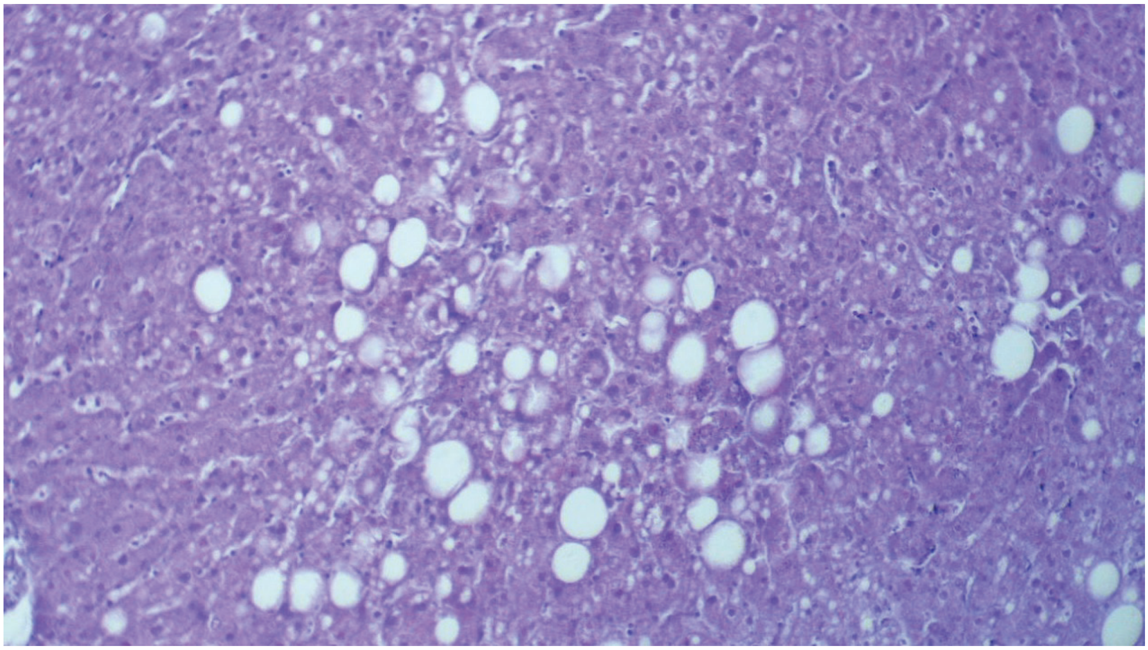

Figure 3: Histopathological section in liver from group fed T2 toxin show hydropic & fatty change within hepatic cell cytoplasm ,disruption in hepatic architucture with pyknotic nuclei as nuclear necrotic changes (H&E)X20

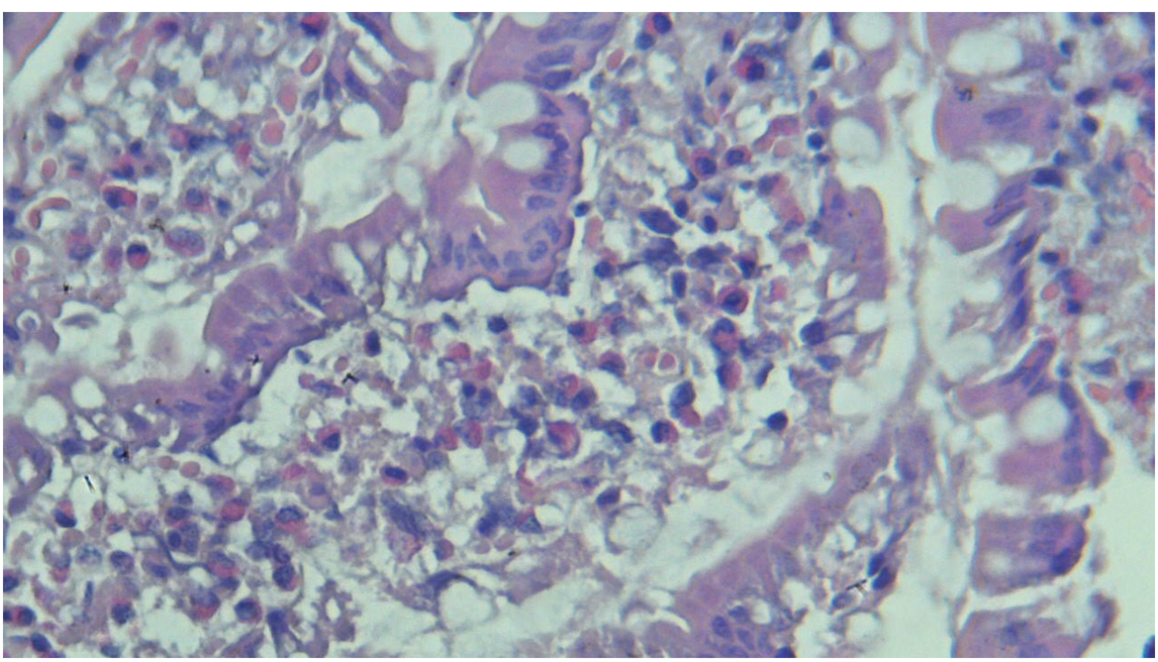

Figure 4: Histopathological picture of intestine from group fed T-2 toxin show hyperactive goblet cells with sever slaughing of epithelia & infiltration of mono nuclear inflammatory cells in lamina propria & muscularis mucosa (H&E)(X20).

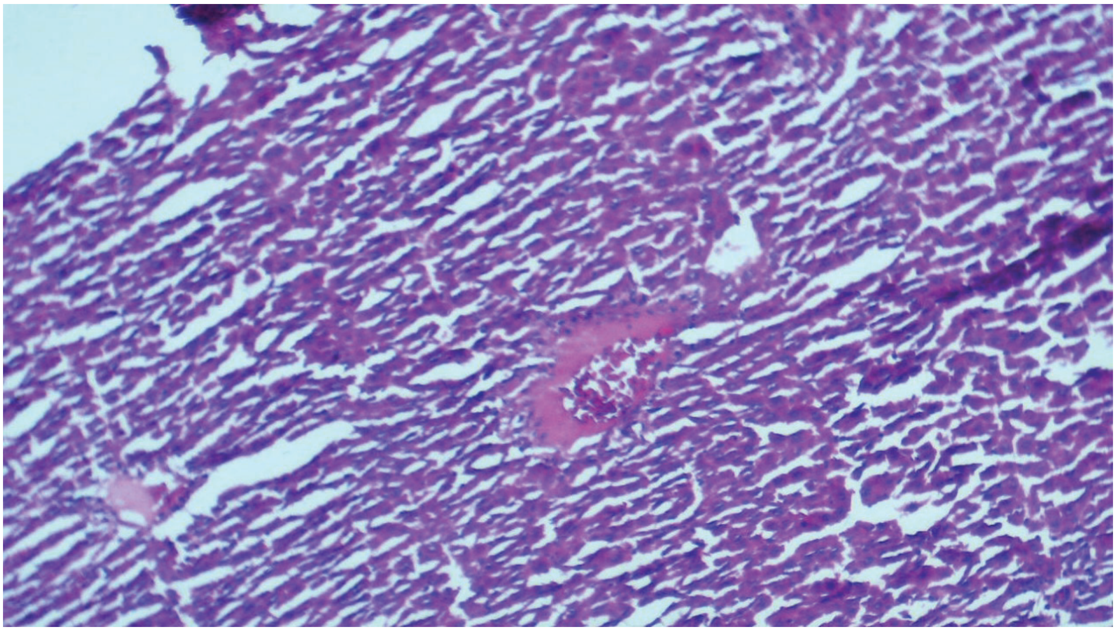

Figure 5: Histopathological section in liver of rat fed with (T2 toxin + organic acid) show congestion of central vein & less pathological changes (H&E) X20.

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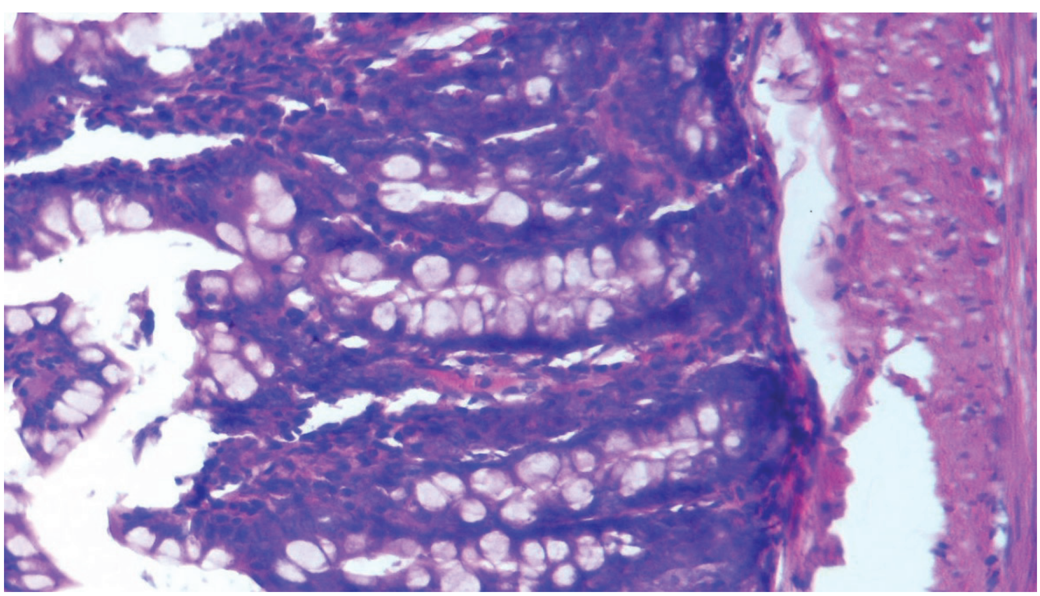

Figure 6: Histopathological picture of intestine from group fed (T-2 toxin + organic acid) show hyperactive goblet cells with mild infiltration of inflammatory cells in lamina propria & muscularis mucosa (H&E)(X20).

Discussion

T-2 toxins, very significance mycotoxins that showed risk to the globe. Four main molecular working of T-2 toxin toxicity were suggested. These include obstacles of DNA, RNA and protein forming concurrently with straight destroys to DNA, promotion of lipid peroxidation, promotion of apoptosis and influence on gene transformation [34]. It is well known that T-2 toxin induces hepatotoxicity, damage to the liver, whether hard or continuous, ultimately introduced in high in serum contents of aminotransferases which include AST and ALT. These enzymes catalyze the transport of α-amino groups from aspartate and alanine to the α-keto bond of ketoglutaric acid to introduce oxalacetic and pyruvic acids respectively, which are vital sharing to the citric acid cycle [35]. ALP is an enzyme that transports metabolites through cell layers. Liver and bone sickness are the dominated of pathological raise of ALP stages [36].

This study, a highness in liver enzymes ALT, AST and ALP1 is noted on 45 and 90 days of oral administration of T-2 toxin. This high in liver enzymes represented hepatocellular destroys which is resulted from T-2 toxin.

Same notes were described by Shinozuka, et al. (2006) and Odetunde, et al. (2016) [37, 38]. In our experimental design we recorded that organs of animals feeds with T-2 toxin show histomorphological changes due to functional & morphological effect of toxin [39, 40].

The liver is consider as the main target organ (in vivo) for the influence of T-2 toxin ,by protein foming obstacle & also decrease the performance of important enzymes which are play an critical role for metabolism of toxic substances [41], these effect will cause focal liver necrosis & mono nuclear cells infiltration [42] & these result agreed with our findings .The liver also show mild to moderate area of vacuolar and fatty infiltration of hepatic cells with focal necrosis , many workers reported corresponding histopathological changes due to T-2 toxin [43,44].

T-2 toxin decreased the cellular metabolic activity, inhibit protein foming & caused severe damage to mitochondrial membranes & endoplasmic reticulum which lead to morphological & functional impairments [45], this elucidate the degenerative changes recorded in our model study .

T-2 toxin also bind to multiple proteins led to decrease activity of enzymes like succinate dehydrogenes which make an act in catabolism of cells & so decrease cellular energy important for vital activity of cell so impairment that lead to degenerative and necrotic changes. [46,47], these findings conform with our histopathological picture recorded in our experiment.

The segment of intestine taken from T2 treated group show villi shortening &hyperplacia of goblet cells with infiltration of lamina propria by lymphocytes, these findings agreed with Nayakawdi et al. (2020) [48].

These findings suggest a direct role of toxin & its oxidative stress effect either by introduce big volume of Ros or little results of antioxidant within the cells. [49, 50] oxidative damage leads to sever histological changes in intestine including tissue damage, lymphocyte infiltration, these result agreed with Hoerr et al. (1982) [51] who recorded mono nuclear cell infiltration and villi atrophy. The radiomimetic activity of T-2 toxin on rapidly dividing cells of intestine might be attributed to development of intestinal lesion [52].

Oxidative stress is the mechanism by which T-2 toxin causes DNA damage and apoptosis. Definitely, T-2 toxin can induce generation of ROS and since the biological membranes are rich in unsaturated fatty acids, the exposure of membranes to peroxidation is common. Additionally, the ROS-mediated mitochondrial pathway plays an important role in T-2 toxin-induced apoptosis [53].

Apoptosis is characterized by cell shrinkage, nuclear pyknosis, chromatin condensation, DNA cleavage into fragments of regular sizes and activation of proteases called caspases. It has been suggested that T-2 toxin generates a pro-apoptotic environment by inducing Fas up-regulation on the chondrocyte surface, and then up-regulate P53 proteins, which in turn increases both the Bax/Bcl-2 and the Bax/Bcl-xL ratios, activates caspase-3, and induces apoptosis[54]. It has also been demonstrated that T-2 toxin induced cytotoxicity in HeLa cells is mediated by generation of ROS leading to DNA damage and transactivation of p53 protein expression. This leads to shift in the ratio of Bax/Bcl-2 in favour of apoptosis and subsequent release of Cyt-c from mitochondria followed by caspase cascade [49].

In the liver T-2 toxin induces oxidative damage precisely by exhausting hepatic glutathione, increasing lipid peroxidation, changing the activity of antioxidant enzymes, and inducing protein oxidation in a time-dependent manner [55] .The generation of free radicals and induction of oxidative stress have been shown to be associated with mycotoxin toxicity. Malondialdehyde (MDA) is largely used as marker of lipid peroxidation [56]. On the other hand, GSH status is an important factor involved in the protection against lipid peroxidation. Both antioxidant enzyme such as CAT, SOD, and GSH-Px and non- enzymatic electron receptors r- GSH are used as indexes to evaluate the level of oxidative stress [57]. In the present study we notice that there is up-regulation of MDA and total oxidative capacity at the end of the study period in addition to reductions in concentration of r-GSH, activities of GSH-Px, SOD and catalase. These results reflected that rats had been exposed to advanced oxidoreductive stress induced by T-2 toxin through a dose and time dependent manner. Previous studies showed similar findings. For example Chang and Mar (1988) [58] and Suneja, et al. (1989) [59] noticed that daily administration of T-2 toxin significantly increased lipid peroxidation in liver of rats as measured by the formation of MDA. It has been reported that ROS generation causes a decrease in Nrf2 expression, and thus changes in the intracellular antioxidant enzymes GSH-Px, GR, SOD and CAT, promoting a decrease in GSH level and an increase in MDA level [60].

A prooxidant effect of T- 2 toxins in many cases could be mediated via changes in reduced glutathione (GSH) concentration. For example, treatment of fasted mice with a single dose of T-2 toxin (1.8 or 2.8 mg/kg body weight) by oral gavage led to marked decrease in hepatic GSH levels [61]. In male broiler chicks, the hepatic GSH concentration decreased after 7 days of treatment (1.5 mg T-2 toxin/kg body weight/day) [62]. Acute exposure of mice to T-2 toxin (4 mg/kg, s.c.) resulted in aprogressive decrease in hepatic GSH content, reaching a minimum 6–8 h after toxin administration.

It was reported that T-2 toxin could affect protein foming by its affinity with trans-peptidase, one of the important subunits in ribosome, and the biofoming of DNA and RNA were also suppressed by T-2 toxin [63]. This can interpret the noticeable down regulation of intracellular r-GSH which was previously noticed by Bouaziz et al. (2006) and Chaudhari, et al. (2009) [64, 49], together with significant reduction in the activities other antioxidant enzymes, a results which totally match the biochemical status of the present study.

Organic acids were benefited from as food additives and preservatives for obstacle food decay, it act in animals, for growth promoter and as an important instrument of controlling all intrinsic bacteria, either the pathogenic or the non-pathogenic [65]. In the present study organic acid shown ameliorative effects on liver enzymes ALT and AST this indicates that organic acid intake is expected to have a beneficial effect on the liver under toxic and inflammatory conditions. Previous study has been carried by Abdeil-Azeeim et al. [66] state an AST is decreased in spite ALT not importantly influenced after the addition of organic acid to the diet of rabbits with high level of starch. Big number of chemical element showed interaction with mycotoxins, so they transformed them to reduced toxic element and damaged them. Organic acids are one of these chemicals which have detoxification effect [67].

Antioxidants have protective properties as a result to their power to work as free radical scavengers, to defend DNA, cell proteins and lipids from mycotoxin-evoking destroying. Several material were used for their power to control the oxidative compression made by mycotoxins, including ascorbate (vitamin C), tocopherol (vitamin E), carotenoid (vitamin A) with flavonoids [68].

Organic acids are recognized with antioxidant effect. Some of them have the ability to donate electrons. Also they may act as a strong scavenger of oxygen-take free radicals like superoxide radical anion, H2O2, the hydroxyl radical, and singlet oxygen in plasma and tissues. Previously it has been established that the addition of organic acids to the diet of rats which treated with T-2 toxin lead to increase the level of antioxidant enzymes like SOD, CAT, and GSH-Px [69] and this compatible with the result of this study.

As oxidative compression makes decisive part in trichothecenes, scholars are attempting to name agents that obstacle T-2 produce oxidative stress via various mechanisms, e.g., decreasing DNA damage, diminishing

ROS generation, reducing lipid peroxidation, and decrease apoptosis necrosis and cell cycle obstacles [70-72] .

So we design this study to detect the role of organic acids which provide applicable methods to decrease compressing stress stages, our findings are agreed with other previous studies such as Monika et al. [73].

Conclusion

The study reveals that the organic acids have a significantly antioxidant, hypoglycemic potential and ameliorate T-2 toxicity, besides the study highlights the impact of the prolonged oxidative stress of T2 toxin on progression of the histopathological lesions in liver and intestine.

Ethical Clearance: The Local Research Ethics Committee of the College of Pharmacy, University of Baghdad, approved the research protocol.

Conflict of Interest: Nil

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