Kerbala Journal of Veterinary Medical Sciences Issue (3), Volume (2), (2026)

Silybum marianum Extract Protects Against Water Restriction Induced Hepatorenal Changes

Rafad abbas Kadhim and Muna Hussain Al-Aameli

College of Veterinary Medicine, University of Kerbala , Kerbala, Iraq.
Corresponding author: raffad.a@s.uokerbala.edu.iq
Received: 19/5/2026 **Accepted:** 21/6/2026 **Published:** 6/9 /2026

***Abstract*—** Dehydration is a dangerous environmental stress that disturbs water and electrolyte balance, causing significant pathological changes in vital organs, especially the liver and kidneys. Therefore, the present study was planned to examine preventive benefits of *Silybum marianum* (milk thistle) seeds contains an effective water insoluble compound knowns silymarin, recently has been widely employed as therapeutic component as a hepato-renal protective, in this study used against dehydration-induced hepatic and renal abnormalities in guinea pigs. Twenty-four adult guinea pigs (*Cavia porcellus*) were randomly separated into four groups (n=6); control, *Silybum marianum*, dehydration groups and dehydration + *Silybum marianum* groups. Dehydration was induced for four weeks by restriction 30% of water intake. Hydroalcoholic extract of silymarin was administered orally to the treated groups during the study period, at a dose of 150 mg/ kg per day for 4 weeks. At the end of the experiment statistical analysis of serum biochemical parameters were performed. Liver and Kidney tissues were taken for histological, histochemical and immunohistochemical examinations utilizing Hematoxylin and Eosin (H&E), Periodic Acid-Schiff (PAS) and Caspase-3 immunostaining. Histopathological results showed Histopathological alternation in the dehydration group, including necrosis of the proximal convoluted tubules, vacuolar degeneration of the hepatocytes, congestion of the blood vessels, and inflammatory infiltration. PAS staining also revealed a reduction in the reactivity of the tissue in the dehydrated animals. However, the tissue architecture and staining intensity were significantly improved in the dehydration + *Silybum marianum* group. Further immunohistochemical evaluation indicated higher expression of Caspase-3 in dehydration group indicating increased apoptotic activity and a decrease of expression after treatment with *Silybum marianum*. In conclusion, results reveal that *Silybum marianum* has hepatorenal protective effects against dehydration induced tissue injury by antioxidant and anti-apoptotic mechanisms.

***Keywords* —** dehydration, silymarin (milk thistle), guinea pig, Caspase-3

INTRODUCTION

Daily water intake is a crucial aspect of veterinary care for animal dietary habits, the volume of drinking water is also affected by the moisture content of the food, the total quantity of dry matter consumed, and the composition of the diet. Due to its involvement in many physical body functions, water consumption differs among the animal's organs and tissues. Mammal's bodies are composed of 60 to 65 percent water. Water is biologically expended through the excretion of urine and feces, necessitating continuous replenishment. Only one-third of the body's water is extracellular (plasma, interstitial space), and the remaining two-thirds is intracellular, the latter compartment is essential for regulating water balance (1). The hepatorenal relationship represents a critical biological crosstalk where the functional integrity of the liver and kidneys is deeply inseparable. In various conditions, such as chronic dehydration and prolonged osmotic stress, a significant impairment often occurs due to systemic vascular dynamics specifically, repeated occurrences of water deprivation cause a marked decrease in renal blood flow and effective blood volume. This leads to a narrowing of renal vessels and reduced glomerular filtration, which may precipitate a progression from acute tubular injury to permanent interstitial fibrosis. Consequently, the simultaneous dysfunction of these two organs, often termed hepatorenal failure, exacerbates by oxidative stress and metabolic disturbances (2,3). The programmed cell death is an energetic biological process that is highly regulated to be the mode by which damaged and surplus cells that are unneeded anymore in the body will be removed from lesional vital organs that initiated either an extrinsic or an intrinsic pathways by 14 members of the caspase family in mammals called caspase-1-14 , Caspase-3 enzyme has been called the key executioner caspase in apoptosis , CPP32 apoptin or YAMA are its other synonyms , caspase-3 is stimulated by caspase 9 and 8 to induce the apoptosis (4,5). The pharmacological importance of milk thistle seeds which scientifically called *Silybum marianum* that belongs to Asteraceae family is polyphenolic extract knowns as Silymarin, which is a complex consist of several flavonolignans such silybin , silycristin , silydianin snd isosilybin, along with flavonoid taxifolin , all these constituents form a strong

antioxidants and anti-inflammatory compound that is protect the cellular integrity by stabilizes the cell's membranes and protect the vital organs tissues from systemic stress impact as well acting as a divers natural curative from environmental and osmotic negative conditions (6,7). The gold standard and the most commonly used staining procedure in histology and diagnostic pathology is the routine hematoxylin and eosin (H&E) stain. It provides a concise and detailed demonstration of tissue architectural, that is stain cell nuclei blue or purple and extracellular matrix pink color (8). Periodic Acid Schiff or PAS stain is a common histochemistry stain for carbohydrate identification in biological and pharmaceutical sciences. Periodic acid oxidizes glycol in the tissue to aldehydes which react with Schiff reagent to give a magenta stain. PAS stains glycogens, basement membranes and mucosubstances, helping distinguish between pathological states, especially in specimens of kidney and liver (9). This study aimed to investigated histological and immunohistochemical changes in liver and kidney induced by dehydration and the protective role of silymarin in mitigating inflammation, oxidative stress and tissue degeneration caused by dehydration in guinea pig.

MATERIALS AND MTHODS

In this study 24 healthy adult Guinea pig weighing 300-500 g commonly used due to their sensitivity to pharmacological. Animals were obtained from the local market in Kerbala and maintained under standard laboratory conditions with free access to food and water. Approved by the research ethic committee at University of Kerbala, College of Veterinary Medicine, under reference number UOK.VET. AN. 2025.140. The guinea pigs were divided into four groups 6 animals in each group (n=6) , control group was normal group received standard diet and water ad libitum, silymarin group received orally silymarin hydro-alcoholic extraction at a dose of 150 mg/ kg per day (10), dehydration group were under dehydration condition by reduce 30% of the daily water intake (11), according to Anderson, the daily water consumption of healthy guinea pigs ranges between 100 and 150 mL/kg of body weight (10-15 mL/100g). Animals were weighed regularly every day to ensure precision their basic need for water was estimated, then a specified quantity which was 30% less than what they required was calculated and administered to them as a requirement, provided only a dry food. And dehydration plus silymarin group were induced dehydration as above and treated with silymarin as the same dose of silymarin group every day for 4 weeks. The silymarin extraction method by using 70% ethanol to socking the finely grounded seeds in it then was heated and filtered to be dried by low temperature to had a powder extract, The silymarin content was evaluated by HPLC analysis model SYKAM (Germany) it was used to analyses add detection of silymarin. the stock solution had been prepared by dissolved the extraction powder in 99% dimethyl sulfoxide (DMSO) then diluted by a normal slain 0.9% to have a 20%DMSO concentration dose 1mL/kg. At the end of the experiment liver and kidney tissues were collected for paraffine sectioning that fixed with neutral buffered formalin 10% then dehydrated by used an escalated levels of ethanol for the preparation of paraffines blocks were microtome sectioning of 6-5 µm thickness and stained with H&E that gives a dark blue to the cellular nucleic acids and pink or orange color to the cellular proteins appearance , PAS Highlights carbohydrates and glycogen stains structures and immunohistochemistry caspase-3 test to investigated the tissues apoptosis lesions microscopically .

RESULT

Histological examination of renal and hepatic tissues demonstrated distinct and consistent structural changes between the experimental groups. The control group showed normal histoarchitecture of both organs with well preserved parenchyma, intact cellular organization and clearly defined structural units (e.g., Fig. 1A, Fig. 3A). Similar to the *Silybum marianum* group, the renal and hepatic morphology was conserved in the majority, with very minor histological changes in the pattern of the renal and hepatic tissue (e.g., Fig. 1B, Fig. 3B). The dehydration group, however, exhibited significant degenerative effects in both kidney and liver tissues such as prominent structural disruption, vascular and cellular congestion, infiltration of inflammatory cells and features of cellular injury such as tubular and hepatocellular degeneration (e.g., Fig. 1C, Fig. 3C). Conversely, treatment with *Silybum marianum* in the plus dehydration group induced significant histological improvement in both organs, with partial recovery of normal architectural pattern, decreased in inflammatory changes and evidence of tissue regeneration with better cellular organization. Collectively these findings suggest that silymarin has a remarkable preventive and ameliorative effect against dehydration induced histopathological damage in both renal and hepatic tissues (e.g., Fig. 1D, Fig. 3D).

Histological and histochemical examination PAS staining demonstrated constant modifications in renal and hepatic tissues in the experimental groups. PAS positivity was intense in the tubular basement membranes, brush borders of proximal tubules and glomerular tufts of the control group indicating normal structural integrity (e.g., Fig. 2A), while the *Silybum marianum* group demonstrated mostly preserved PAS reactivity with rare hyaline cast deposition (e.g., Fig. 2B). However, in the dehydration group, the PAS staining intensity was significantly reduced. Tubular and glomerular components were weakly reactive and mesangial matrix expansion was seen, showing considerable structural disturbance (e.g., Fig. 2C). However, administration of silymarin in dehydration group resulted in moderate restoration of PAS positive suggesting partial repair of renal histoarchitecture (e.g., Fig. 2D). Similarly, in hepatic tissue, the control group showed the high PAS reaction in blood vessel walls, bile ducts and hepatocyte cytoplasm (e.g., Fig. 4A), whereas the *Silybum marianum* group showed only minor loss of glycogen content (e.g., Fig. 4B). The dehydration group had a significant depletion of PAS-positive material indicating decreased glycogen reserves (e.g., Fig. 4C). The dehydration plus *Silybum marianum* group had improved PAS staining intensity with moderate recovery of glycogen distribution in hepatocytes and associated structures (e.g., Fig. 4D). Collectively, these findings demonstrate that Silybum Marianum has a protective effect against the depletion of PAS positive components caused by dehydration in renal and hepatic organs.The

immunohistochemical examination of caspase-3 expression in the kidney and liver tissues showed evident and consistent variations among the experimental groups. In kidney, the control group showed weak caspase-3 immunostaining in renal tubules and negative expression in the glomeruli, indicating little baseline apoptotic activity (e.g., Fig. 5A). In contrast, the *Silybum marianum* group showed modest tubular expression exclusively (e.g., Fig. 5B). On the other hand, dehydration group exhibited intense caspase-3 immunostaining mainly in cortical tubular areas, with a marked increase in apoptosis (e.g., Fig. 5C). Dehydration plus *Silybum marianum* group showed mild to moderate expression, suggesting that apoptotic activity was partly attenuated (e.g., Fig. 5D). Similarly, poor caspase-3 expression was detected in liver tissue of the control group (e.g., Fig. 6A), while mild immunoreactivity was observed in *Silybum marianum* group (e.g., Fig. 6B). However, the dehydration group showed high caspase-3 positivity in hepatocytes associated with increased apoptotic cell death(e.g., Fig. 6C). Treatment with *Silybum marianum* showed moderate expression largely concentrated in hepatocytes and periportal bile duct regions (e.g., Fig. 6D). In summary, these results suggest that *Silybum marianum* exhibits a strong anti-apoptotic impact in renal and hepatic tissues after dehydration caused damage.

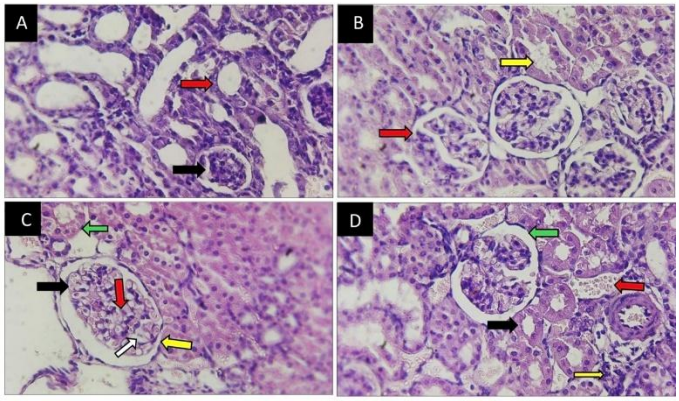

Figure 1. Histological section of Guinea pig's kidney, (A : Control group , B : *Silybum marianum* group , C : Dehydration group , D : Dehydration +*Silybum marianum* group) cross section (H &E).

A : control group kidney Showing Normal morphology of the renal parenchyma with well-defined glomeruli (black arrow) and renal tubules (red arrow), (40 x) .

B :Histological section of *Silybum marianum* group kidney showing well-defined Bowman's capsules and intact capillary tufts (red arrow) with regular tubules & brush border of the proximal tubules remains intact (yellow arrow) H&E stain (40 x) .

C : Histological section of dehydration group kidney showing vacuolation and congestion of the glomerular , dilated capillary spaces with congestion (black arrow) with detachment of capillary basement membrane (white arrow) and flattening of the podocytes (yellow arrow) & increased mesangial matrix (red arrow) with necrosis in the proximal convoluted tubules (green arrow) H&E stain (40 x) .

D :Histological section of dehydration +*Silybum marianum* group kidney showing regeneration of renal tubules(black arrow) and improved glomerular morphology (green arrow) by improved tubular epithelial integrity with slight interstitial congestion (red arrow) with slight infiltration of inflammatory cells in the interstitial tissue (yellow arrow) H&E stain (40 x) .

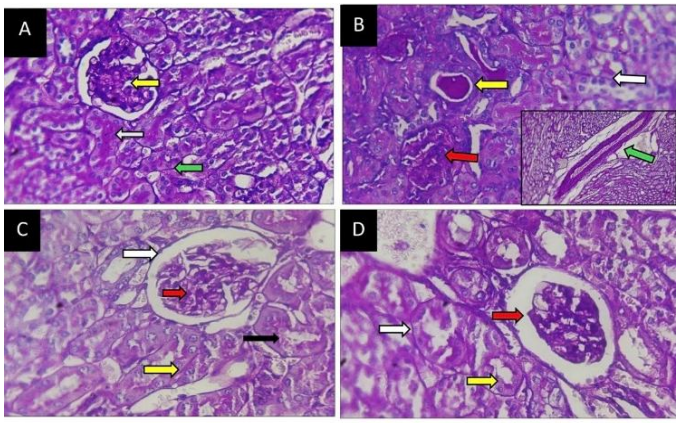

Figure 2. Histological section of Guinea pig's kidney , (A : Control group , B : *Silybum marianum* group , C : Dehydration group , D : Dehydration +*Silybum marianum* group) cross section (PAS).

A : Histological section showing strong PAS reaction for basement membrane of tubules (green arrow) & brush border (white arrow) and glomeruli with glomerular tuft (yellow arrow) PAS stain (40 x).

B : Histological section *Silybum marianum* group showing strong PAS reaction for blood vessels wall (green arrow) that stained purplish color (10 X) , and PAS reaction for basement membrane of tubules (white arrow) and glomeruli with glomerular tuft (red arrow) with deposition of hyaline cast in the tubules (yellow arrow) PAS stain (40 x).

C : Histological section in the kidney of dehydration showing mild PAS reaction for basement membrane of tubules (yellow arrow) and brush border of proximal tubules (black arrow) with glomerular basement membrane (white arrow) with Mesangial cells (red arrow) PAS stain (40 x).

D : Histological section of dehydration +*Silybum marianum* group showing moderate PAS reaction for basement membrane of tubules (white arrow) &brush border of proximal tubules(yellow arrow) and glomeruli with glomerular tuft (red arrow) PAS stain (40 x).

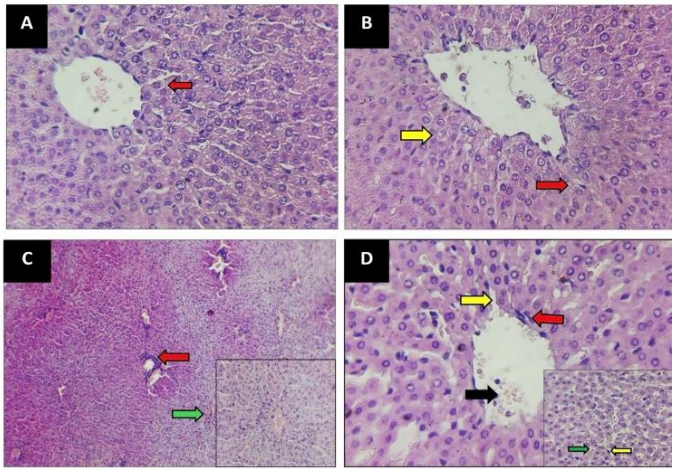

Figure 3. Histological section of Guinea pig's Liver, (A : Control group , B : *Silybum marianum* group , C : Dehydration group , D : Dehydration +*Silybum marianum* group) cross section (H &E).
A : Histological section of the liver of control group showing regular architecture of hepatic lobules (red arrow) H&E stain (40 x).
B : Histological section of *Silybum marianum* group showing slight vacuolization of sporadic hepatocytes (yellow arrow) with apparent Kupffer cell activation (red arrow) H&E stain (40 x) .
C : Histological section of dehydration group liver showing centrilobular necrosis (green arrow) and inflammatory cells infiltration (red arrow) H&E stain .
D : Histological section of the liver of dehydration +*Silybum marianum* group showing regular architecture of hepatic cord (yellow arrow) with mild inflammatory cells infiltration (red arrow) around dilated central vein with mild congestion (black arrow) , slight sinusoidal congestion (green arrow) & Kupffer cell hyperplasia duct (yellow arrow) H&E stain (40,10 x) .

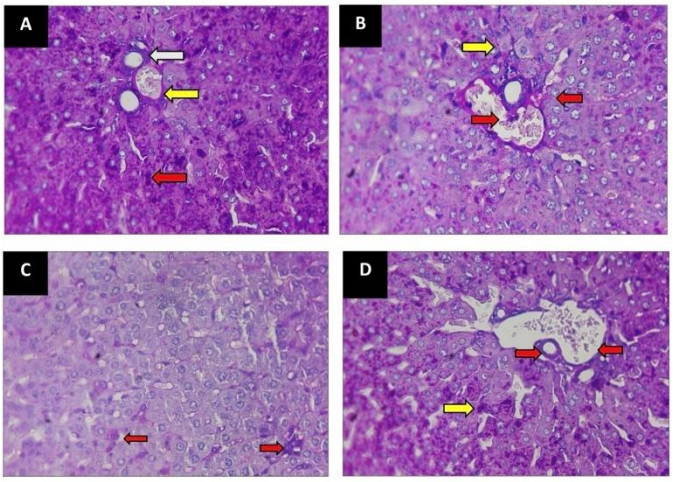

Figure 4. Histological section of Guinea pig's Liver , (A : Control group , B : *Silybum marianum* group , C : Dehydration group , D : Dehydration +*Silybum marianum* group) , cross section (PAS).

A : The liver of control showing strong PAS reaction around blood vessels (yellow arrow) with around bile duct (white arrow) and cytoplasm of hepatocytes(red arrow).
B : Liver of *Silybum marianum* group showing mild intensity of staining for glycogen in the wall of blood vessels & bile duct (red arrow) with cytoplasm of hepatocytes (yellow arrow) .
C : The liver of Dehydration group showing mild PAS reaction for cytoplasm of hepatocytes (red arrows).
D : Histological section of dehydration +*Silybum marianum* group liver showing moderate Intensity of staining for glycogen in the wall of blood vessels & bile duct (red arrow) with cytoplasm of hepatocytes (yellow arrow) PAS stain (40 x).

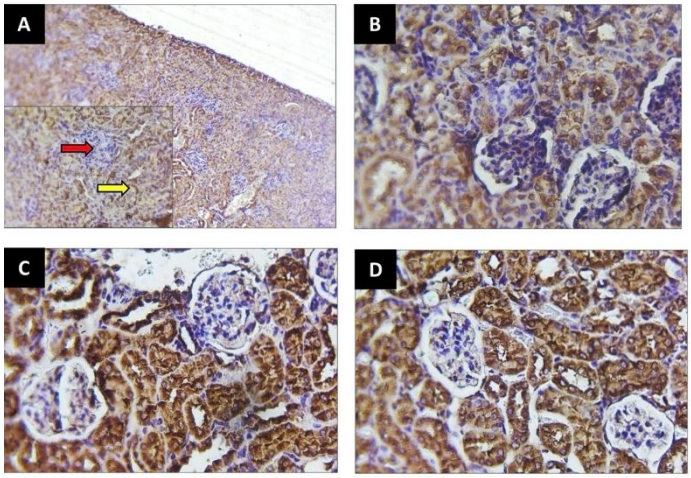

Figure 5. Immunohistochemistry (IHC) section of Guinea pig's kidney , (A : Control group , B : *Silybum marianum* group , C : Dehydration group , D : Dehydration +*Silybum marianum* group) .
A : Kidney of control group showing weak caspase-3 expression in the tubules & negative caspase-3 expression in the glomerular.
B: Kidney of *Silybum marianum* group showing mild caspase-3 expression in the proximal convoluted tubules.
C: Kidney of dehydration group showing strongly caspase-3 expression in cortical areas in the tubules.
D: Kidney of dehydration +*Silybum marianum* group show moderate caspase-3 expression in the glomerular (Caspase-3 immune Staining, 40x).

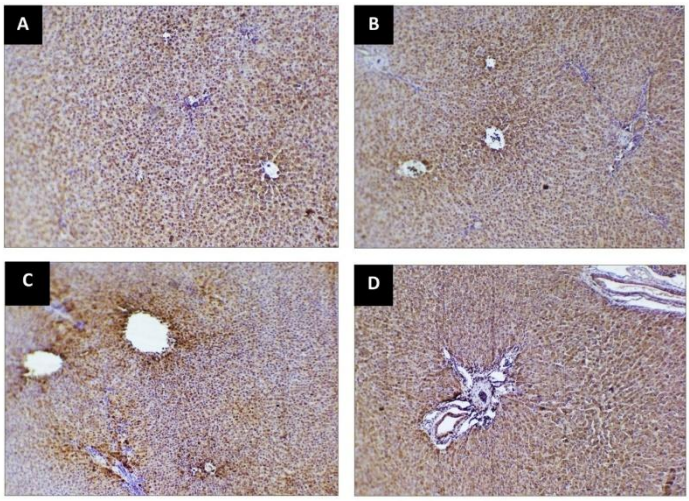

Figure 6. Immunohistochemistry (IHC) section of Guinea pig's Liver , (A : Control group , B : *Silybum marianum* group , C : Dehydration group , D : Dehydration +*Silybum marianum* group) A: Liver of control group showing weak caspase-3 expression , B: Liver of *Silybum marianum* group showing mild caspase-3 expression ,C: Liver of dehydration group at one month showed strongly caspase-3 expression , D: Liver of dehydration +*Silybum marianum* group showing moderate caspase-3 expression in the bile duct & hepatocytes around portal area that stain brown color (Caspase-3 immune Staining,10x) .

DISCUSSION

The present investigation offers wide histological, and immunohistochemical evidences for the structural and functional effects of dehydration on renal and hepatic tissues in addition to the protective role of Silybum marianum. In control group, both kidney and liver tissues revealed preserved cytoarchitecture in H&E and PAS staining, with intact glomeruli, well-organized tubular structures and normal hepatic lobular organization. This is consistent with previously reported normal histology of mammalian renal and hepatic tissues (12,13). On the other hand, dehydration caused severe degenerative changes in the organs including destruction of the tubular epithelium, disruption of the glomeruli, vascular congestion, hepatocellular necrosis and infiltration of inflammatory cells. The substantial drop in PAS reactivity also reflects depletion of glycogen storage and disruption of basement membrane integrity, indicating profound metabolic and structural damage. These findings are in agreement with prior studies of renal dysfunction and reduction in glomerular filtration generated by dehydration accompanied with hypoperfusion (14). The high expression of Caspase-3 in the dehydration group was a strong indication of the activation of the apoptotic pathway. This activation is probably due to the accumulation of reactive oxygen species (ROS) because of prolonged water deprivation which impairs the integrity of the mitochondrial membrane and releases pro-apoptotic molecules. Mechanistically, agree with study that is observed tissue damage might be attributed to oxidative stress and excessive production of ROS leading to lipid peroxidation, protein denaturation and DNA damage (15). This oxidative cascade favors activation of apoptotic pathways as evidenced by the substantial elevation of caspase-3 expression in both renal and hepatic tissues in the dehydration group. Furthermore, the infiltration of inflammatory cells and necrosis of hepatocytes in the liver further enhance the ROS-mediated tissue injury and the development to organ failure (16,17,18). Importantly, *Silybum marianum* treatment ameliorated these degenerative alterations. Histological amelioration of renal and hepatic architecture, partial restoration of PAS-positive components and diminished caspase-3 expression indicate abatement of structural damage and apoptosis. These effects are consistent with earlier research revealing hepatoprotective and renoprotective activities of *Silybum marianum* and its active component silymarin (19,20). The protective function is could be attributed to its potent antioxidant capacity, free radical scavenging activity , as well as its ability to stabilize cellular membranes and alter apoptotic signaling pathways (21).In conclusion, the integrated findings of this study reveal that silymarin extract a profound multi-target protective effect on dehydration-induced renal and hepatic injury via suppressing oxidative stress, inhibiting apoptosis, and preserving structural and metabolic integrity.

CONCLUSION

This study approved the protective role of *Silybum Marianum* as antioxidant by reduce the free radicals that induced by dehydration situation to stabilized the basement membrane of hepatorenal tissue and the prophylactic role to the cellular apoptosis by stabilizing the programed cell death when it is used as corroborative supplement.

Acknowledgements
N/A

Conflict of Interest
The authors declare no conflict of interest.

REFERENCES

1) Wolf, P., Cappai, M. G., & Kamphues, J. (2020). Water consumption in small mammals (dwarf rabbits, Guinea pigs and chinchillas): New data about possible influencing factors. *Research in veterinary science*, *133*, 146-149.

2) Yang, X., Wu, H., & Li, H. (2020). Dehydration-associated chronic kidney disease: a novel case of kidney failure in China. *BMC nephrology*, *21*(1), 159.

3) Rao, S. K. (2025). TWIN challenges of Nephrology Acute Kidney Injury & Acute Liver Failure or Hepato-Renal Failure. *International Journal of Clinical Nephrology*, *4*(1).

4) Bebars, S. M., Al-Sharaky, D. R., Gaber, M. A., & Afify, D. R. (2017). Immunohistochemical expression of caspase-3 in psoriasis. *Journal of clinical and diagnostic research: JCDR*, *11*(7), EC01.

5) Aydogan, A., Kocer, G., Ozmen, O., Kocer, M., Onal, L., & Koskan, O. (2014). Immunohistochemical expression of caspase-3, caspase-5, caspase-7 and apoptotic protease-activating factor-1 (APAF-1) in the liver and kidney of rats exposed to zoledronic acid (ZOL) and basic fibroblast

growth factor (bFGF). *Veterinary Quarterly*, *34*(3), 137-142.

6) Fehér, P., Ujhelyi, Z., Váradi, J., Fenyvesi, F., Róka, E., Juhász, B., ... & Vecsernyés, M. (2016). Efficacy of pre- and post-treatment by topical formulations containing dissolved and suspended Silybum marianum against UVB-induced oxidative stress in guinea pig and on HaCaT keratinocytes. *Molecules*, *21*(10), 1269.

7) Çolak, İ. A., & Çelik, S. A. (2025). Silybum marianum L. Gaertner.: A Review of Its Traditional Uses, Phytochemistry and Pharmacology. *Selcuk Journal of Agriculture and Food Sciences*, *39*(2), 487-493.

8) Gamble, M., & Wilson, I. (2008). The hematoxylins and eosin. *Theory and practice of histological techniques*, *6*, 121-34.

9) Shedge, S., Roy, P., Shedge, A., & Doshi, M. A. (2020). Periodic acid schiff (PAS) staining: A useful technique for demonstration of carbohydrates. *Prof.(Dr) RK Sharma*, *20*(4), 41405.

10) Hossain, M. M., Hwang, H. S., Jang, S. Y., Yu, S., & Kim, I. H. (2024). Supplemental impact of silymarin in growing pig diet on the growth performance, total tract digestibility, faecal microflora, faecal noxious gas emission and absorption rate in blood. *Journal of Animal Physiology and Animal Nutrition*, *108*(1), 206-214.

11) Anderson, N. L. (2009). Pet rodents. *Saunders Manual of Small Animal Practice*, 1881.

12) Rajab, J. M., Abbood, A. S., & Mohsin, R. A. (2024). Comparative histological study of the kidneys in two types of mammals. *Pharma. Innov. J*, *13*(11), 86-91.

13) Yousif, N. H., Hadi, H. D., & Jihad, H. M. (2012). *Histological study of liver in guinea pig Cavia porcellus (Linnaeus, 1758) in Iraq. Revis Bionatura 2023; 8 (3) 80*. J. Vet. Sci.

14) Alayyannur, P. A., & Ramdhan, D. H. (2022). Relationship of heat stress with acute kidney disease and chronic kidney disease: a literature review. *Journal of Public Health Research*, *11*(2), 22799036221104149

15) Varzi, H. N., Esmailzadeh, S., Morovvati, H., Avizeh, R., Shahriari, A., & Givi, M. E. (2007). Effect of silymarin and vitamin E on gentamicin-induced nephrotoxicity in dogs. *Journal of veterinary pharmacology and therapeutics*, *30*(5), 477-481

16) Morishima, C., Shuhart, M. C., Wang, C. C., Paschal, D. M., Apodaca, M. C., Liu, Y., ... & Polyak, S. J. (2010). Silymarin inhibits in vitro T-cell proliferation and cytokine production in hepatitis C virus infection. *Gastroenterology*, *138*(2), 671-681.

17) Ali, M. A., Abu Damir, H., Ali, O. M., Amir, N., Tariq, S., Greenwood, M. P., ... & Adem, A. (2020). The effect of long-term dehydration and subsequent rehydration on markers of inflammation, oxidative stress and apoptosis in the camel kidney. *BMC veterinary research*, *16*(1), 458.

18) Clementi, A., Virzì, G. M., Sorbello, M., Marzano, N., Monciino, P., Cabrera-Aguilar, J. S., ... & Zanella, M. (2025). Hepato-Renal Crosstalk in Acute and Chronic Disease: From Shared Pathways to Therapeutic Targets. *Biomedicines*, *13*(7), 1618.

19) Tedesco, D. E. A., & Guerrini, A. (2023). Use of milk thistle in farm and companion animals: a review. *Planta Medica*, *89*(06), 584-607.Oda, S. S., & El-Ashmawy, I. M. (2012). Protective effect of silymarin on mercury-induced acute nephro-hepatotoxicity in rats. *Glob Vet*, *9*(4), 376-83.

20) Shaker, E., Mahmoud, H., & Mnaa, S. (2010). Silymarin, the antioxidant component and Silybum marianum extracts prevent liver damage. *Food and Chemical Toxicology*, *48*(3), 803-806.

21) Soto, C., Pérez, J., García, V., Uría, E., Vadillo, M., & Raya, L. (2010). Effect of silymarin on kidneys of rats suffering from alloxan-induced diabetes mellitus. *Phytomedicine*, *17*(14), 1090-1094.