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The Effect of Magnetic Water in Some Bio-Chemical Parameters when Exposure to UVC Radiation in Experimental Mice

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Abstract: In this study (100) adult of albino mice aged (7-8) weeks were used, the mice are divided into four groups. The aim of this study is to review the scientific results of effect of Magnetic Water in white mice when exposure to UVC Radiation by measurements of some bio-chemical parameters such as Dihydrofolate reductase (DHFR) and Glutathione reductase enzymes. The body weight of mice before and after administration of magnetic water (MW), there were significant differences between the females and males in four groups in other hand there were significant differences between the females in these groups also there were significant differences between the males, the results were shown that the animals after administration of magnetic water (MW) (after 14 days) were increased in weight. DHFR enzyme activity in testis/ovaries of mice had been shown no significant differences between females and males in control groups (before using UVC and after administration of magnetic water), there were significant differences between the females and males in four groups in other hand there were significant differences between the females in these groups also there were significant differences between the males. The results of Glutathione reductase enzyme had been shown no significant differences between females and males in four groups, there were significant differences between the females in four groups in other hand there were significant differences between the males in these groups. As conclusion that the magnetic water treatment is one of the most effective non-chemical methods to prevent scaling, corrosion and microbiological fouling in various industrial sectors.

Keywords: magnetic water (MW), DHFR enzyme, Glutathione reductase enzyme, UVC Radiation.

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Introduction

In the life the water is very important in transport compounds such as blood and maintains of its cellular structural integrities, regulates temperature, etc.., recently many researchers suggested that possible bio-effect on magnetic water. The application of magnetic water is exposing water to magnetic field that alters the configuration of water(1,2). It means passing water in magnetic tubes, by putting a magnet in water so properties of water turn into very fertile and active, causing high oxygen ratio, velocity of dissolved salts and amino acids in water. Natural water after sterilization is called dead water, so

magnetic water transfer water from dead to live (3).

Magnetic water treatment is a method of supposedly reducing the effects of hard water by passing it through a magnetic field as a non-chemical a Hortative to water soften .Magnetic treatment is regarded as unproven and unscientific Water gets magnetically charged when it is contacted with Magnet (4,5) . Al though magnetic water products have been promoted since the 1930S, they have received little recognition due to question effectiveness. Diethylnitrosamine (D E N) is a widely occurring nitrosamine that is one of the most important environmental carcinogens primarily inducing tumors of live (4). Magnetic is an ore has an electro-attraction property, there is relation between Magnetic field and water the water consist of two types of atoms, hydrogen and oxygen, were connected to get water molecule. when the water molecule flow inside Magnetizing field the bounds atoms absorbing energy and increasing the ability of the atoms to set free by electric analysis, Subsequently rebuild the crystallization structure by reconnection between atoms and Minerals ions (6). The rust is water polarization would be more and increase of water. Solubility (7).

Dihydrofolate reductase (DHFR) catalyzes the NADPH-dependent reduction of dihydrofolate (DHF) to tetrahydrofolate (THF) (6). The enzyme catalyzes the reduction of 7, 8-dihydrofolate (DHF) to 5,6,7,8-tetrahydrofolate (THF) using nicotinamide adenine dinucleotide phosphate (NADPH) as the cofactor (8).

Glutathione is an intracellular antioxidant, acting as a "trap" for free radicals as well as being a co-substrate in peroxide detoxification reactions catalyzed by glutathione peroxidase and glutathione transferase. Glutathione reductase contributes to the reduction of oxidized glutathione. Changes in the level of reduced glutathione have been observed in various human cancer cells and are an important factor in the pathology of cancer development (9).

The aim of this study is to review the scientific results of effect of Magnetic Water in white mice when exposure to UVC Radiation by measurements of some bio-chemical parameters such as Dihydrofolate reductase (DHFR) and Glutathione reductase enzymes.

Methods

I-Animals

In this study (100) adult of albino mice aged (7-8) weeks, weighted (18-20) g was used in this study (provided from the Animal`s House in the College of Veterinary Medicine, University of Baghdad). Animals were placed in the room ranged temperature (20-25) Cº and lighting ranged (12) hrs. light and (12) hrs. darkness and distributed in cages for creditors authority totals and by need experience and for the duration of trials was to give animals water and bush integrated.

The mice are divided into four groups:

1. First group: Control group (5 males and 5 females) without UVC Irradiation and magnetic water.
2. Second group: Was used to characterize the degree of UVC irradiation on mice. The UVC source placed at (20) cm above the mouses

`cage, where the final UVC power at the mouse was (1.2) mW for (1) h. The animals were (30) which were (15) females and (15) males which were grouped in subgroups the animals were killed after (7,14,21) days, for each group was (5) females and (5) males.

3. Third group: was employed to study the influence of Magnetic water (M.W.). (30) animals were (15) females and (15) males were given Magnetic water which grouped in subgroups, the animals were killed after (7,14.21) days, for each group was (5) females and (5) males.
4. Fourth group: was employed to study the influence of UVC irradiation on the animals which treatment with M.W. which grouped in subgroups, the animals were killed after (7,14.21) days, for each group was (5) females and (5) males.

II- Magnetic Water Preparation:

Magnetic water was prepared by passing drinking water through Magnetized Funnel (Fig.1) by rate (0.5) meter/sec (which slowly). The produced magnetic strength was (500) Gauss (measured by a WT10A Tesla meter), which is an average value of the magnetic field strength used in experimental animals and proved to have no pathological effect (10).

Figure (1): Magnetized Funnel.

III- Dihydrofolate reductase enzyme assay

The assessment of enzyme activity for DHFR enzyme

Mice were killed in separated the spinal cord and explained directly for testis/ovaries, and put it in test tube, then added (1ml) (PBS). Grind the testis with fine sand by mortar according to(11).

The DHFR enzyme activity was analysis according to the method of Haurani *et. al.* (12) with little modification. The assay for DHFR was performed at 37°C by spectrophotometer method, which utilizes the decrease in absorbency at 340 nm when NADPH and dihydrofolate are converted to NADP and tetrahydrofolates Enzyme activity is expressed as nano mol dihydro-folate reduced/mg protein .The reaction mixture contains 2 ml (NADHP) 2mm. 0.6ml of dihydrofolate and 50 ml of

enzyme suspension and read at every minute for 3 min (13).

V- **Glutathione reductase enzyme assay**:

1- Preparing the Tissue Extract:

Mice were sacrificed by cervical dislocation for liver (1g) was cut into very small pieces by using a sharp knife, and put it in the test tube, then added (1ml) (PBS) by manual mechanical pressure. Mashed the live tissue well until the solution became viscous, transferred the product to a centrifuge and centrifuged at a speed of (5000) rpm for 1 hour. The filtrate was taken and the sedimented layer was left at the bottom of the test tubes, avoiding the fatty layer at the top of the filtrate, and kept in freezer (20) mint until evaluation or direct use to estimation of enzyme activity.

2- The assessment of enzyme activity for Glutathione reductase enzyme:

Racker (15) method was used to estimate enzyme activity in a final volume. The reaction mixture contains of :(0.1) ml of enzyme extract, (0.1) ml of (1%) bovine serum albumin,(0.4) ml of (2%) oxidized glutathione and (0.4) ml of NAPH+ ,then the reaction mixture was read in a spectrophotometer on a wavelength of (340)nm, and the reading were recorded every (30) seconds (14,15)

$$\text{Enzyme Activity} = \frac{\text{Total volume} \times \Delta^{o}}{0.01 \times 1 \times \text{volume of enzyme extract} \times T2-T1}$$

- (Δ^{o}) indicates to the decrease in adsorption.
- (T2-T1) indicates to the change in time.

VI- Hematoxylin and Eosin investigation

Liver was fixed in 4% paraformaldehyde and embedded in paraffin; 5-µm thick sections were prepared and were deparaffinized, rehydrated and subjected to Hematoxylin & Eosin (H&E) staining with the routine protocol (16).

VII- Data analysis

The statistical analysis was done using the SPSS version 20.0 software for data entry and analysis, the results were expressed as mean±SD. The data were statistically analyzed using analysis of variance (ANOVA) to determine the associations between two categorical variables. *P*-value ($p \leq 0.05$) was considered statistically significant.

Results and Discussion

Magnificat field considered as a simple biological technique to simulation of what happens in the nature, as magnetic water to became more biologically active. Magnetic water means passing water through magnetic tubes, the properties of water change to became very active and fertile, because of an increase in oxygen ratio, the amino acids and the velocity of dissolved salts in water (17)

Figure -2 was shown the body weight of mice before and after administration of magnetic water (MW), there were significant differences between the females and males in four groups in other hand there were significant differences between the females in these groups also there were significant differences between the males, the results were shown that the animals after administration of magnetic water (MW)(after 14 days) were increased in weight. These results were agreement

with many studies such as Ebrahim and Azab: " Physics shows that water changes weight under the influence of magnetic fields. More hydroxyl (OH-) ions are created to form alkaline molecules, and reduce acidity. Increasing both the electric conductivity and the dielectric constant of water was documented " (3).

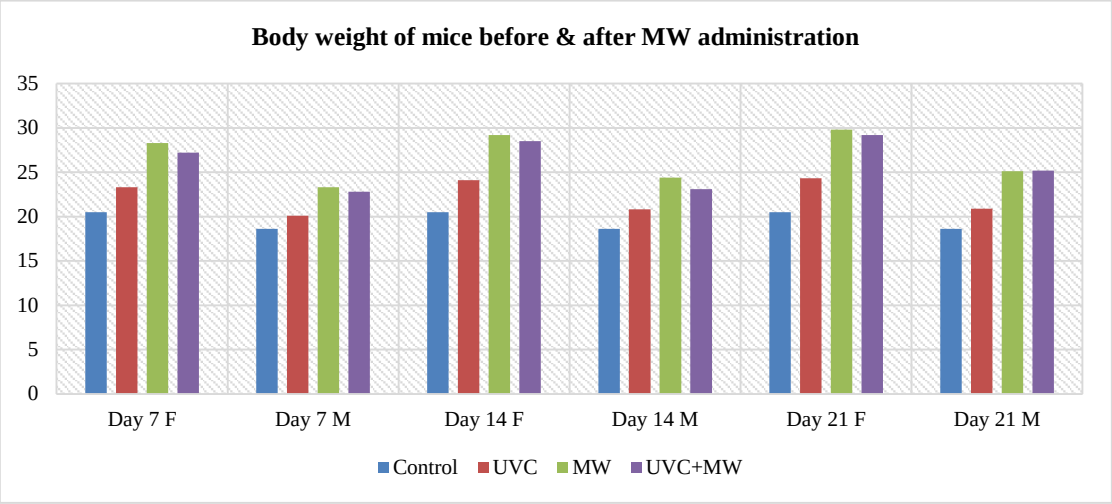

Figure (2): Body weight of mice before and after administration of magnetic water (MW).

The DHFR enzyme which Dihydrofolate reductase catalyzes the reduction of 7, 8-dihydrofolate (DHF) to 5,6,7,8-tetrahydrofolate (THF) using nicotinamide adenine dinucleotide phosphate (NADPH) as the cofactor (8). Magnificat field considered as a simple biological technique to simulation of what happens in the nature, as magnetic water to became more biologically active. Magnetic water means passing water through magnetic tubes, the properties of water change to became very active and fertile, because of an increase in oxygen ratio, the amino acids and the velocity of dissolved salts in water (17)

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differences between the females in these groups also there were significant differences between the males. Most of researcher is clear that the effect of UVC radiation on enzyme production by increase when using radiation (13), in other hand there were interactions between enzyme`s active site, the coenzyme, individual amino acid residues of the enzyme and water molecules in the catalytic reactions. These interactions of the enzyme with the many of competitive inhibitors are widely now used in medicine as antitumor and antibacterial drugs (18).

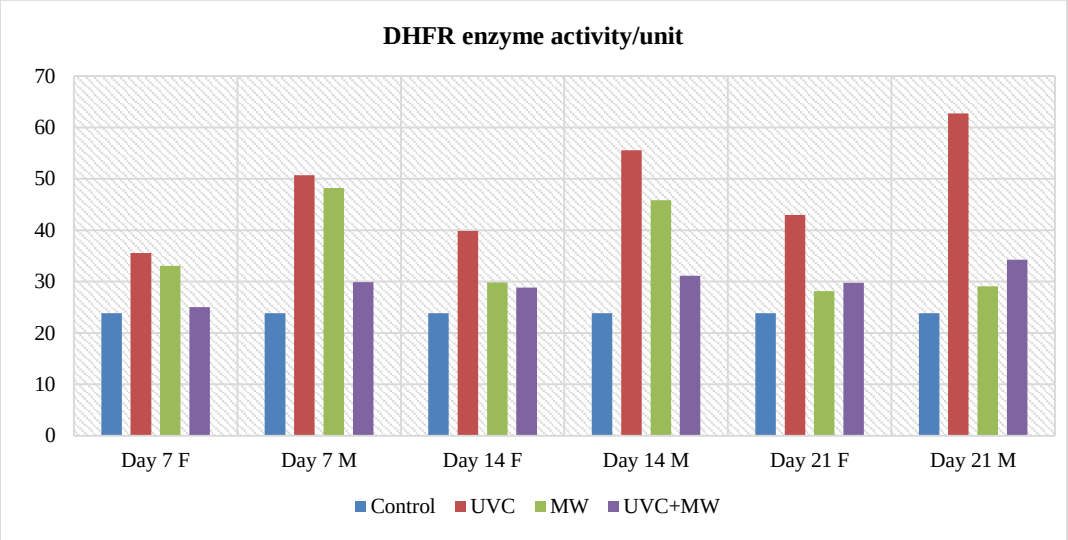

Figure (3): Shown the DHFR enzyme activity /Unit.

Glutathione, the tripeptide γ-glutamyl-cysteinyl-glycine, plays a key role in detoxification and 45 redox buffering processes in the cell, Reduced glutathione (GSH) is the most vital 47 intracellular non-protein thiol compound and plays a major role in the protection of cell and 48 tissue structures from oxidative injury (19). Figure -4 was shown: there were no significant differences between females and males in four groups, there were significant differences between the females in four groups in other hand there were significant differences between the males in these groups. The glutathione system is an active participant in the antioxidant defense of the body and can be used to characterize the cell condition of gliomas at various stages of tumor development. An important role in the protection of cells against free radical oxidation belongs to indicators characterizing glutathione defense adequacy (9).

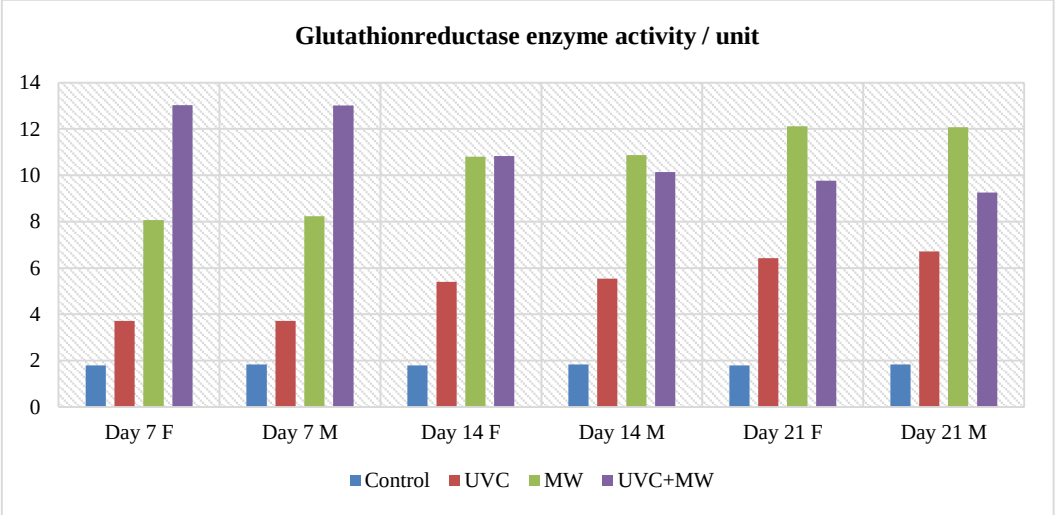

Figure (4): Shown the Glutathion Reductase Enzyme Activity /Unit .

The changes of the liver after of UVC irradiation on mice were detected by the architecture of liver lobule has been lost(Fig-5), smaller hepatocytes with more eosinophilic cytoplasm and flat nuclei, Necrotic area of liver characterized by all the cell in the section lost their nuclei, moderate hemosiderosis and some oval cell scattered in the section compare with control group (Fig-6) which shows branching and anastomosing cords of hepatocytes radiating from the central vein. The hepatocytes have vesicular nuclei and some of them appear binucleated. The cells are separated by the blood sinusoids lined by Bat endothelial cells. The repair action of Magnetic Water after exposure to radiation (Fig-7). A) low magnification shows high cellularity near portal area, B), C, D, E, High magnification shows high cellular density of the liver stem cells (oval cells) and the hepatocytes contain large irregular hyperchromic nuclei. E, G, F, few endothelial cells present associated with oval cells and hepatocytes.

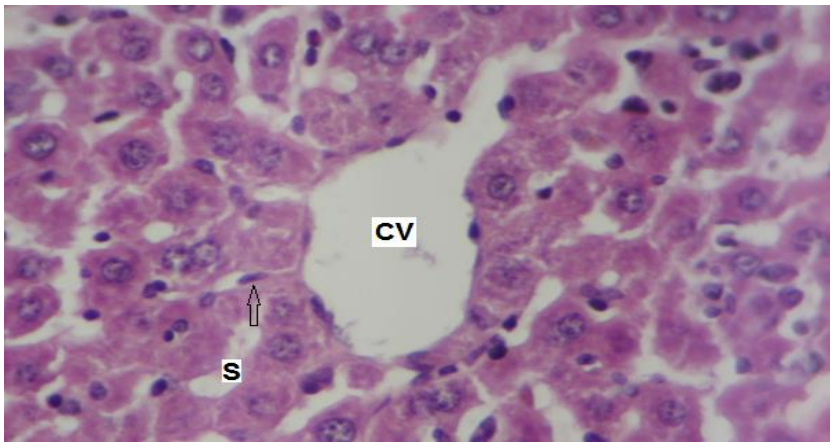

Figure (5): Liver in Control group: Shows branching and anastomosing cords of hepatocytes radiating from the central vein (C.V.). The hepatocytes have vesicular nuclei and some of them appear binucleated. The cells are separated by the blood sinusoids (S.) lined by Bat endothelial cells (↑) (H&E X 400).

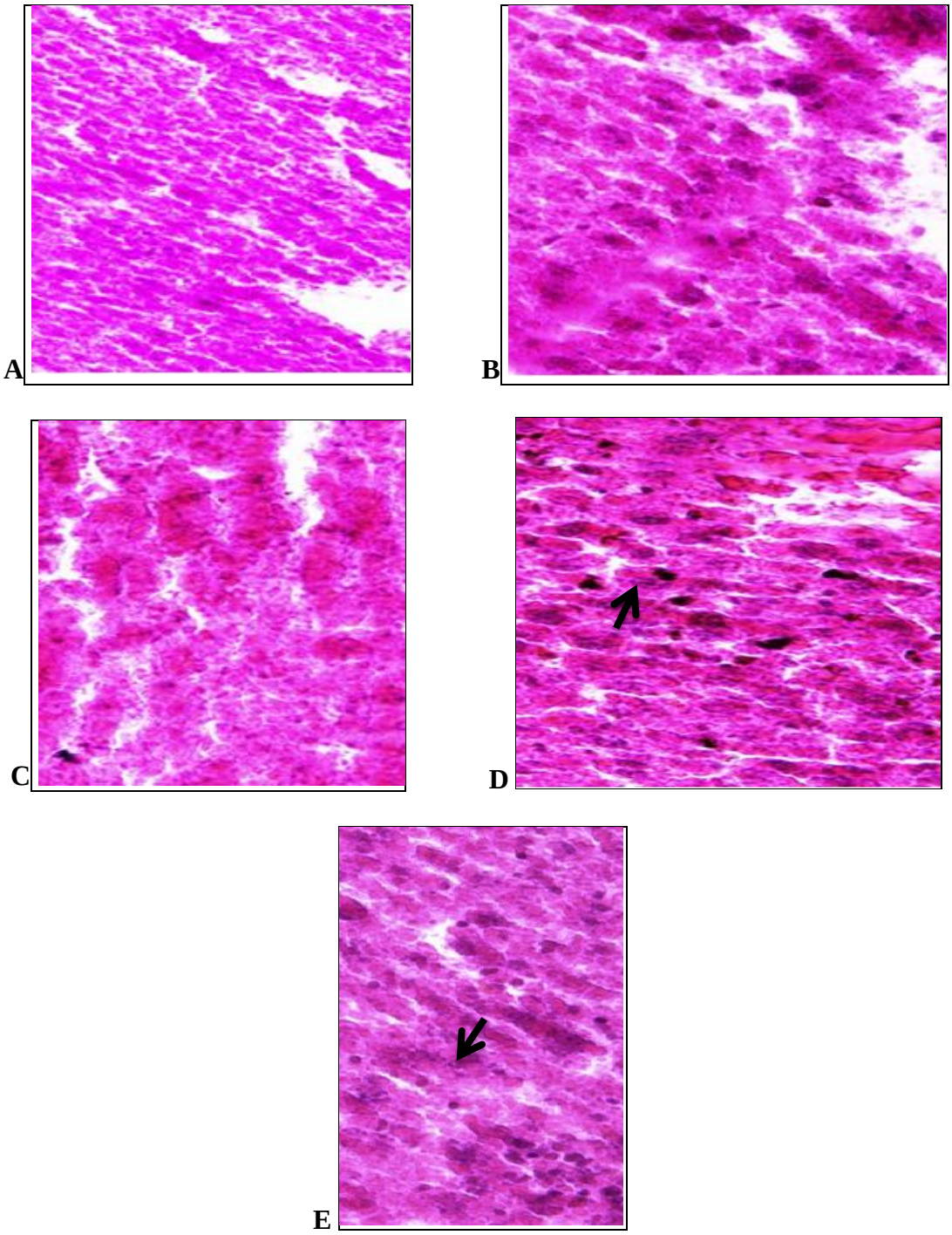

Figure (6): The effect of UV radiation on the hepatic tissue. A) the architecture of liver lobule has been lost X10. B) Smaller hepatocytes with more eosinophilic cytoplasm and Fint nuclei. C) Necrotic area of liver characterized by all the cell in the section lost their nuclei X40 D) moderate hemosidrosis (arrows) and E). some oval cell scattered in the section (arrows) X40.

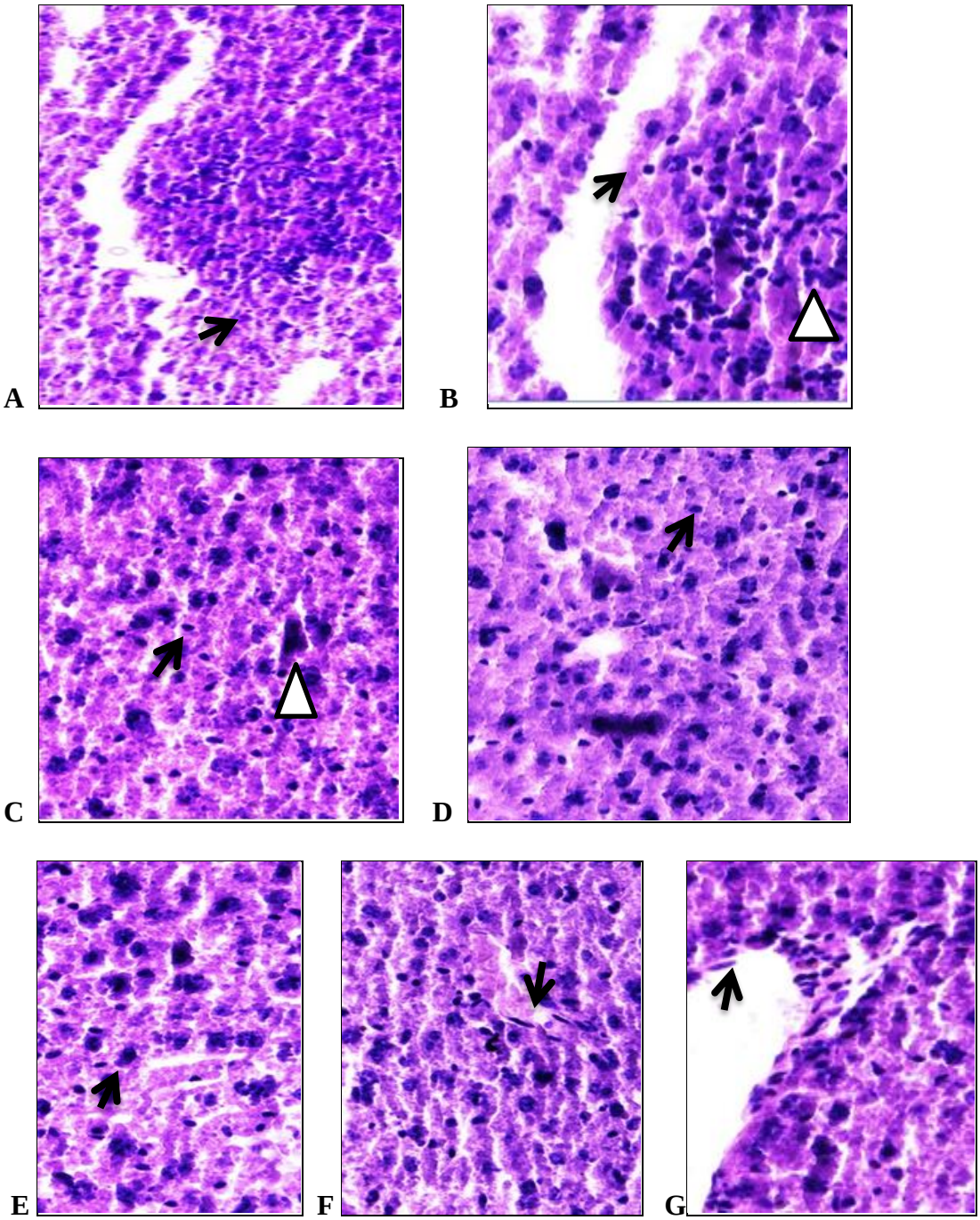

Figure (7): liver of mice treated with Magnetic Water after exposure to radiation. A) low magnification shows high cellularity near portal area X10, B), C, D,E, High magnification shows high cellular density of the liver stem cells (oval cells) (Black arrows) and the hepatocytes contain large irregular hyperchromic nuclei (white head arow) X40. E, G,F, few endothelial cells present (arrows) associated with oval cells and hepatocytes X40.

Conclusion

It is claimed by many technologists and scientists that the magnetic water treatment is one of the most effective non-chemical methods to prevent scaling, corrosion and microbiological fouling in various industrial sectors. Many researchers have evaluated

Magnetic Water Treatment Devices (MWTD) worldwide for scale control in various industrial processes, including desalination, and also for desorption of scales and corrosion products (20). The utilization of magnetic water treatment has been implemented for numerous decades as a technique for managing and averting the accumulation of scale in both industrial and residential water systems (21). The compressive strength of concrete samples mixed with magnetic water at a magnetic strength of 1T increases by 10-20% more than that of normal water". Also, the consistency of fresh concrete is improved in case of magnetic water than that of normal water (22). In other hand It was discovered that magnetic water, field and nanoparticles could reduce the drug toxicities in animal studies. To promote cancer treatment by chemotherapy, therapeutic innovation (magnetic related technology) is indispensable(23).

References

1. Al-hammer, A.H.; Sadiq, G.T. and Yousif, Sh. (2013). Effect of Magnetized Water On Several Biochemical and Physical Properties in Mice. Journal of Babylon University/Pure and Applied Sciences. 21(3) :910-916.
2. Al- Sabry, M.; Hassan, A.; Eleid, T.A. and Abou-Hashim, F. (2024). Drinking Magnetized water Alters Blood constituents and structure of Spleen and Kidney in Rabbits. Online Journal of Animal and Feed Research, 14(2): 86-94.
3. Ebrahim, S. A. and Azab, A. E. (2017). Biological Effects of Magnetic Water on Human and Animals. Biomedical Sciences, 3(4), 78-85.
4. Lee, H.J.; Jo, H.R.; Jeon, E.J. and Kang, M.H. (2010). Effect of the magnetized water supplementation on lymphocyte DNA damage in mice treated with diethylnitrosamine. Korean Journal of Nutrition, 43(6), 570-577.
5. Lee, H. J. and Kang, M. H. (2013). Effect of the magnetized water supplementation on blood glucose, lymphocyte DNA damage, antioxidant status, and lipid profiles in STZ-induced rats. Nutrition Research and Practice, 7(1), 34-42.
6. Rodriguez, M.; Petitclerc, D.; Nguyen, D. H.; Block, E. and Burchard, J. F. (2002). Effect of electric and magnetic fields (60 Hz) on production, and levels of growth hormone and insulin-like growth factor 1, in lactating, pregnant cows subjected to short days. Journal of Dairy Science, 85(11), 2843-2849.
7. Al-Bayar, M. A.; Mahmood, R. M. and Saieed, A. Y. (2020). Magnetic treated water, reality and applications: A review. Plant Archives, 20(2), 732-737.
8. Galenkamp, N. S. and Maglia, G. (2022). Single-Molecule Sampling of Dihydrofolate Reductase Shows Kinetic Pauses and an Endosteric Effect Linked to Catalysis. ACS Catalysis, 12(2), 1228-1236.
9. Obukhova, L.; Kopytova, T.; Murach, E.; Shchelchkova, N.; Kontorshchikova, C.; Medyanik, I., *et al*. (2022). Glutathione and Its Metabolic Enzymes in Gliomal Tumor Tissue and the Peritumoral Zone at Different Degrees of Anaplasia. Current Issues in Molecular Biology, 44(12), 6439-6449.
10. Al-Saffar, S. F.; Amer, N.; Zaki, L. S.; Faris, A. S.; Imran, N. J.; Nadhim, Z. F., *et al*. (2013). Effect of magnetized water on histological structure of heart, lung and spleen of albino rats. Al-Nahrain Journal of Science, 16(4), 152-160.
11. Morton, R. K. (1954). The purification of aklaline phosphatases of animal tissues. Biochemical Journal, 57(4), 595-603.
12. Haurani, F. I.; Kardinal, C. G. and Biermann, W. A. (1978). Thymidylate synthetase and dihydrofolic acid reductase in the stimulated human lymphocyte. Journal of Cellular Physiology, 95(1), 49-55.
13. Ahmed, Sh.J.; Rasheed, M. K. and Abdul Ghafour, K. H. (2013). Correlation study between DHFR enzyme and some biochemical parameters in diabetic type II patients. IOSR Journal of Applied Chemistry, 3(3), 54-57.
14. Owens, C. W. and Belcher, R. V. (1965). A colorimetric micro-method for the determination of Glutathione. Biochemical Journal, 94(3), 705-711.

15. Racker, E. (1955). [127] Glutathione reductase1 (liver and yeast). In Methods in Enzymology, 2: 722-725.
16. Downie, T. (1990). Theory and Practice of Histological Techniques Edited by J.D. Bancroft and A. Stevens, Churchill Livingstone, Edinburgh, 740. Histopathology, 17(4), 386-386.
17. Aziz, E.; Ahmed, B. A.; Ramadan, S. and Mahboub, H. D. (2022). Effects of magnetic water on productive performance, behaviour, and some physiological responses of Nile tilapia fish (Oreochromis niloticus) reared under normoxia and hypoxia conditions. Assiut Veterinary Medical Journal, 68(175), 76-89.
18. Polshakov, V. I. (2001). Dihydrofolate reductase: structural aspects of mechanisms of enzyme catalysis and inhibition. Russian Chemical Bulletin, 50(10), 1733-1751.
19. Foyer, C. H. and Noctor, G. (2011). Ascorbate and glutathione: the heart of the redox hub. Plant Physiol, 155(1), 2-18.
20. Ozair, G. and Gutierrez, J. T. (2010). An overview of magnetic water treatment system & further course of study. J. Int. Environmental Application and Science, 5(5), 965-974.
21. Bayoumi, S.; Moharram, N. A.; Fayed, M. and El-Maghlany, W. M. (2024). Assessing the efficacy of magnetic water treatment: A concise review and experimental investigation. Desalination and Water Treatment, 100369.
22. Zaki, S. I.; Shawky, M.; El Rahman, B. A. A.; El-Nashar, M. H.; Zakrya, E. and Zaki, M. G. (2024). Effect of Magnetic Water on Properties of Fresh and Hardened Concrete. In Materials Science Forum, 1123: 59-74.
23. Da, Y. L. and Yi, L. (2025). Magnetic water and clinical cancer chemotherapy. Nursing and Care Open Access Journal. 2025;11(1): 36-37.