Int. J. Bio-Inorg. Hybr. Nanomater., 10(2): 95-101, Summer 2021

The effect of MgO@FO nanoparticles on liver tissue in male mice injected with thioacetamide

M. Nasr esfahani, Gh. R. Amiri, N. Naghsh*

Falavarjan Branch, Islamic Azad University, Isfahan, Iran

Received: 28 November 2020; Accepted: 31 January 2021

ABSTRACT: Background and Aim: There are many promising advances in biological detection and the use of nanostructures and multifunction devices. The Qur'an also mentions foods that undoubtedly paying attention to them and applying the instructions given about them can ensure physical and mental health. In this study, the protective effects of liver hydroathanolic extract of fig and olive in Quranic ratios of 1: 7 in the prevention of thioacetamide-induced liver damage in male mice were investigated. Materials and Methods: In this study, doses of 75, 150 and 300 mg/kg MgO@FO were injected into one-month-old male mice. Chemical precipitation method was used to synthesize MgO (2 to 3 nm) and MgO@FO quantum dots. Their physical properties were evaluated by X-ray diffraction (XRD), visible ultraviolet (UV) spectroscopy and transmission electron microscopy (TEM). Results: Histological studies of liver tissue in the group treated with plant extracts and nanoparticles. The nanoparticles coated with hydroethanolic extract of fig and olive oil had the least damage and bleeding compared to the group receiving thioacetamide at a concentration of 100 kg/mg. It was shown that the obtained MgO@FO quantum dots have a high hexagonal crystal structure. Conclusion: The combination of hydroethanolic extract of fig and olive fruit with Quranic ratios may protect the liver tissue probably by increasing the activity of antioxidant compounds in the above extract and thus reducing oxidative stress and lipid peroxidation caused by thivastamide.

Keywords: *Liver tissue, Mice, MgO, Nanoparticles, Thioacetamide*

INTRODUCTION

Nanotechnology is the science of studying the basics of molecules and structures with dimensions between 1 and 100 nanometers. These structures are called nanostructures. Nanotechnology is the application of these structures in nanometer-sized devices. As the dimensions of the object become smaller, the ratio of area to volume increases, the higher the drop, the higher the ratio. As the level increases, the number of atoms on the surface increases. As the dimensions of the material become smaller and reach the nano-dimensions, the surface of the material and, by its nature, the atoms on the surface of the material also increases very much, and as a result, the material becomes highly unstable. All the organs of the living organism move towards the most stability and the lowest level of energy. A material that has reached the dimensions of nanoclay, due to its high instability, tends to move towards stability in dif-

(*) Corresponding Author - e-mail: amiri@iaufala.ac.ir, amiri.nano@gmail.com

ferent ways, and this stabilization leads to a change in properties. One of these methods is to change the arrangement of atoms. As previously explained, with a slight change in the arrangement of atoms (change in bond length or bond angle), the properties of materials also change [1-7].

Nanotechnology or nanotechnology is a field of applied knowledge and technology that covers a wide range of applications. The main issue is the inhibition of material or devices in dimensions less than one micrometer, usually about 1 to 100 nanometers. In fact, nanotechnology is the understanding and application of new properties of materials and systems in these dimensions that show new physical effects, mainly due to the dominance of quantum properties over classical properties. Nanotechnology as the fourth wave of the industrial revolution is a huge phenomenon that has found its way into all scientific trends and is one of the new technologies that is developing rapidly. Also, nanotechnology is a highly interdisciplinary and disciplined science. Materials such as materials engineering, medicine, pharmacy, veterinary medicine, biology, applied physics, semiconductor devices, supermolecule chemistry and even mechanical engineering, electrical engineering and chemical engineering.

The interdisciplinary nature of nanoscience and nanotechnology as the ability to produce new materials and tools and systems with precision atom and molecule, will sooner or later affect the medical and health sector, including the drug delivery system inside the body. The Impact of Nanotechnology on Medicine, Health Care, and the Environment The activity of living systems is primarily due to the behavior of molecules at the nanoscale. Now all disciplines including chemistry, physics, medicine and biology have moved to these scales. This multidisciplinary insight paves the way for the rapid advancement of nanobiotechnology. Molecular building blocks of life (lipids, proteins, nucleic acids, hydrocarbons and their non-biological substitutes) are all materials that have specialized and reproducible properties due to their dimensional size, reproducibility and nanoscale. Nanotechnology, which is currently the most advanced and newest human technology and causes a great change in medicine, chemistry, physics, etc., is among the strategic sciences and its importance is far greater than nuclear technology. Numerous synthesis methods are being developed or improved to increase properties and reduce production costs. Some methods have been modified to obtain process-specific nanoparticles to enhance the optical, mechanical, physical and chemical properties [1-7].

MATERIALS AND METHODS

Synthesis, coating and evaluation of properties

Wet chemical method was used to synthesize MgO nanoparticles. First, three solutions of mercaptoethanol (ME), sodium hydroxide (NaOH) and magnesium sulfate (all from Merck) were prepared in distilled water and stirred vigorously. The magnesium sulfate solution was then poured into a balloon container. A diluted inhibitor drop was then added to the same balloon every 4 seconds. Finally, sodium hydroxide was added to the balloon in the same way until the solution gradually turned white until a white solution was obtained. To extract any impurities, the final solution is washed several times with deionized water and after washing, the solution is poured into a human and placed in an oven (at a temperature of 70 °C for 48 hours to dry. After 48 hours, nanoparticles We take the dried material out of the oven, then pour it on a clean surface and powder it with a tool, pour the powdered material into a jar and put it in the oven and set the oven temperature to 700 °C. And put the material in the oven for 3 hours to dry completely (Note: the three hours we have to consider for drying should be calculated from the time when the oven temperature has reached 700 degrees Celsius).

To prepare 70% hydroethanolic extract, you must first mix 70 cc of ethanol with 30 cc of distilled water in an Erlenmeyer flask and then carefully weigh 50 g of dry plant powder (6.5 g of fig powder+43.5 g of olive powder) carefully. It is weighed and poured on a mixture of ethanol and distilled water. The lid is tightly closed and then placed on a shaker (Rotator model 2002 from Behdad-Iran) for 48 hours to mix the ingredients thoroughly. After 48 hours, remove the mixture from the shaker and then pass it through filter paper. Fig and olive extract were used to coat magnesium oxide nanoparticles. Pour 0.6 g of nanoparticles in 100 cc of distilled water and dissolve. Then pour the dissolved nanoparticles into the balloon and connect the suction tube to the balloon. Pour 100 cc of the filtered extract into the soxhlet and open the milk so that a drop of the extract is added to the nanoparticles every 4 seconds. After this, add some distilled water to the solution and wash it several times to remove excess extracts. After washing, pour the solution into the plate and place it at a temperature of 40 °C until the solution evaporates and the powder is obtained. After the solutions dry in the plate, we cut them from the bottom of the plate and collect them. XRD (X-ray diffraction, Bruker D8 ADVANCE λ = 0.154 nm Cu Kα) and UV-Vis spectrophotometer (Ultra Violet-Visible, UV-2600 Shimadzu, Japan) were used to evaluate the optical and structural properties of MgO@FO. Particle size distribution was assessed by TEM (Transmission Electron Microscope, Ferdowsi University of Mashhad).

Breeding and treatment of animals

In this study, male Wistar rats weighing 200 ± 20 g were used. The animals were randomly grouped and kept under standard conditions of 12 hours of light and 12 hours of darkness with a temperature of 23±2 °C. During the keeping period, the animals had free access to sufficient water and food. Hydroethanolic extraction method was used to adapt and bring the extract closer to the traditional medicine system and the Quranic subject. Dried powder was used to prepare doses of 75, 150 and 300mg/kg body weight in mice. The animals were randomly divided into groups of 6. All groups except the control group received thioacetamide at a concentration of 100 mg/kg after 28 days of daily gavage to mice on day 29. Intraperitoneal injection of thioacetamide into mice was performed using an insulin syringe.

The first group was healthy controls who received only water and food. The second control group received thioacetamide injection, which received thioacetamide (liver toxin) only on the 29th day without medication. The third group received metformin at a concentration of 300 mg/kg. The treatment groups 4, 5 and 6 received the extracts of fig plants + synthesized magnesium nanoparticles by gavage with doses of 75, 150, 300 mg/kg of Buddha, respectively. The important point is that all groups received 0.5 mg of drugs and extracts by gavage on one day. At the end of the 28th day, after a day of rest, and on the 29th day, all groups except the control group received thioacetamide in the amount of 0.5. CC was received by intraperitoneal injection.

Histological study of liver

24 hours after the last treatment, at the end of the experiment after anesthesia of mice, the liver of mice is completely removed and after accurate weighing for histopathological studies, keep in 10% formalin and then with normal histological methods after staining with hematoxylin. Eosin was stained and then processed for histopathological examination under a light microscope. The morphological structure of the liver was examined.

Statistical analysis

In this study, after preparing the information of blood sampling results in Excel file, data analysis was performed using the general difference of meaning 1 of SPSS software version 22. Therefore, first, using ANOVA method between different groups was determined, using Duncan test, the differences between the treatment groups and each group were examined separately for the factors that showed differences. One-way analysis of variance was used to compare the means of the groups. Then the mean activity of enzymes in different groups was compared with each other and with the control group. Significance levels of 1% and 5% were considered.

RESULTS

XRD, TEM and UV-Vis results

Absorption spectra

The crystal structure of MgO was examined by XRD. Figure 1 shows the XRD MgO pattern. The diagrams obtained are shown in Fig. (1). The sample is single-phase compared to the 1235-01 reference card and also has a cubic crystal structure. The average particle size was determined by the Debye-Scherer formula and the approximate size of the synthesized magnesium oxide crystals was calculated as 15-14 nm.

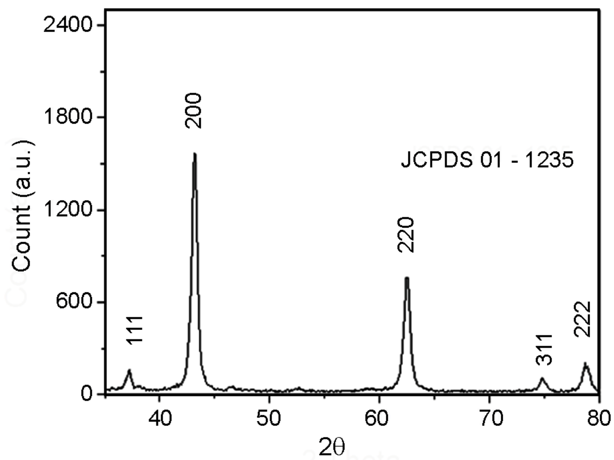


Fig. 1. XRD pattern of the MgO.

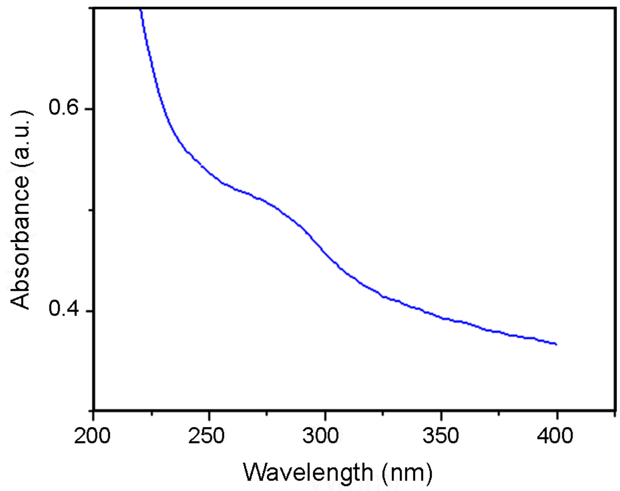


Fig. 2. UV spectrum of synthesized MgO nanoparticles

The UV-Vis absorption spectrum was measured with a visible UV spectrophotometer (TCC240A, Shimadzu, Japan). Fig. 2 shows the MgO absorption spectrum that these particles have at peak wavelengths of 200 to 600 nm. Then, in the range of 200 to 400 nm, the adsorption of magnesium oxide nanoparticles was read and plotted as a curve. The adsorption shoulder of magnesium oxide nanoparticles is in the range of 250 to 300 nm. The difference in adsorption in different patterns of magnesium oxide nanoparticles depends on the size of the nanoparticles. The larger size of the nanoparticles has the greater adsorption. According to the absorption diagram obtained, the adsorption shoulder at approximately 285 nm is observed for the nanoparticles synthesized in this study.

Transient electron microscopy is one of the tools by which the size, shape and properties of nanostructures can be examined. One of the most accurate methods for examining and estimating the size of nanoparticles is the use of an electron microscope. In this study, a transmitting electron microscope image was synthesized from a sample of MgO nanoparticles in Fig. 3. In sample electron microscopy, the average particle size of MgO is about 25 nm, which due to the size of the nanoparticles means that each particle is composed of a single crystal and MgO nanoparticles have a hexagonal structure. By carefully examining the shape and calculating the size of a large number of particles in the figure, it can be seen that nanoparticles have a spherical shape and also most of the particles have a uniform size distribution. Also, the synthesized particle size was 25 nm randomly.

Microscopic slides were taken from the liver of all groups. The results of histological studies of the liver in the control group showed that the liver tissue is normal in the lobules and there are no signs of destruction of the lobules and bleeding in the central veins. Also, hepatocytes do not have pathological changes. The nuclei are also nochromatic (have a natural color) and no effect of necrosis, apoptosis, cytolysis and inflammation was observed. The margins of the cells were

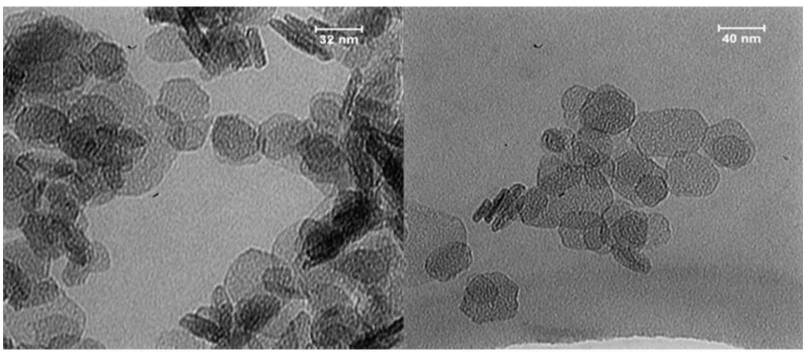
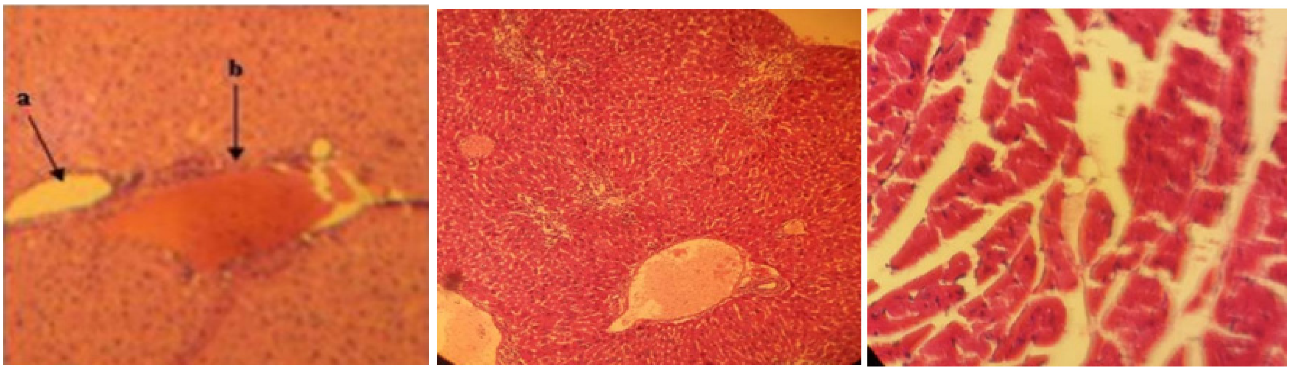


Fig. 3. Electron microscope image of a synthesized magnesium oxide sample

well defined and the nuclei were clearly visible. The port spaces were also quite natural and with regular cellular arrangement (Fig. 4. No. 1). In the thioacetamide-injected group, the effects of hemorrhage in the central veins with the accumulation of RBCs are quite evident, indicating pathological changes (these changes included: liver fibrosis, apoptosis, nuclei were more prominent and wrinkled, Cell enlargement, cytoplasmic acidophilia, cellular tissue structure were somewhat disrupted, and mitotic cytolysis was observed to be abnormal (indicative of the effect of the substance consumed on liver tissue). These lesions were mostly seen around the central veins and were rarely seen in the port space of inflammatory reactions. Liver tissue sections showed small hemorrhages in the lobules with accumulation of blood in the central veins and sinusoids (Fig. 4. No. 2). In the group receiving metformin, hepatocytes also do not have pathological changes. It is clear (Fig. 4. No. 3). In the group receiving the synthesized extract along with the synthesized nanoparticles at a concentration of 75 mg/kg, hyperemia with cell necrosis and dilation of the central lobular vein space (flashes) are observed. The nuclei were also seen as normal and without inflammation. In this slide, sinusoids were not observed in the central veins with bleeding (Fig. 4. No. 4). Hepatocytes are normal and triadport components are normal. The lips have also been destroyed (Fig. 4. No. 5). In the group receiving 300 mg/kg, pathological effects on the liver slide were quite evident, which was mainly seen in the form of severe bleeding both in the sinusoids and in the vascular space (central vertebrae and triadport components), which shows the profound effects of the injection on liver tissue. No trace of macrophage or tissue necrosis was observed (Fig. 4. No. 6).

DISCUSSION AND CONCLUSION

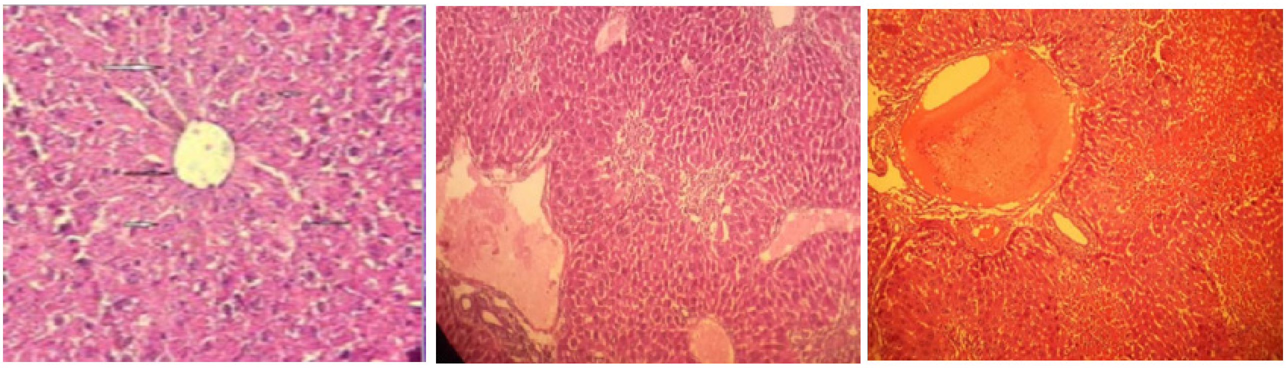
Based on scientific and traditional findings, significant success has been shown in the treatment of acute diseases cured by Islamic herbal medicines. Phenolic compounds have antioxidant activity, which are classified into flavonoids, phenolic acids, coumarins and tannins based on their chemical structure. Due to their ability to act as electron donors and the chelating



Picture No.1 (x100)
(a: bile ducts) and (b: port vein)

Picture No.2 (x100)

Picture No.3 (x100)



Picture No.4 (x100)

Picture No.5 (x100)

Picture No.6 (x100)

Fig. 4 (No. 1-6). All bulbs are from cross section of liver tissue with magnification (x100).

properties of metal ions, they can exhibit the activity of adsorption or inhibition of free radicals (such as CCL4 due to carbon tetrachloride metabolism) which are capable of the activity of aspartate aminotransferase, alanine aminotransferase, alkaline They are very low in serum and are also able to reduce the level of lipid peroxidation (TBARS) and liver lipid peroxidase and have anti-inflammatory properties, which in figs are antioxidant compounds, including flavonoids and polyphenols and some biologically active compounds such as arabic. Amirin, ß-carotene, glycosides, etc., and in olives in addition to phenols, there are oleocanthal (responsible for causing a bitter taste in olive oil) and tocopherols (known as active vitamin E) and Fatty acids in olive oil, such as oleic acid, linoleic acid, and alpha-linolenic acid, have similar functions to nonsteroidal anti-inflammatory drugs, which have anti-inflammatory and antioxidant properties. A mild to moderate increase in alkaline phosphatase and hepatomegaly in a patient with inflammatory bowel disease may indicate fatty liver disease, and serum levels of the alkaline phosphatase enzyme further indicate bile duct function and damage, especially extrahepatic ducts [7-15]. On the other hand, oxygen reactive species of ROS play an important role in changes in liver pathology. Biological membranes are one of the most sensitive parts of cells to the effects of ROS against peroxidation of unsaturated fatty acids in biological membranes, which in addition to reducing fluidity, destroys them. Although intracellular protective mechanisms greatly reduce the damage caused by ROS, due to the high production of these free radicals, the existence of other protective methods, especially plant samples and natural compounds that have antioxidant properties, is very important for human health. Antioxidants protect the cell against free radicals. So despite the abundant antioxidant compounds in figs and olives appear. They play an important role in the treatment and elimination of free radicals to protect the liver. What is certain is that the positive effect of the combined extract of fig and olive fruits with Quranic ratios 1 and 7 on histopathological changes in the liver indicates a decrease in the amount of hyperemia and fat metamorphosis in liver cells and regeneration of port or central lobule vein (CV) spaces. The synergistic effect of the combined extract increases with increasing the dose in the treatment group with a dose of 75 mg/kg. Quran 1 and 7 require different organs of the body. The results of this study showed that magnesium oxide nanoparticles coated with hydroethanolic extract of fig and olive caused changes in liver tissue. The results of the present study show that in the liver tissue of the group injected with thioacetamide, the effects of bleeding are quite evident, which indicates the effect of liver toxin on the liver tissue. They also showed no pathological changes, which means that metformin had little effect on liver protection. We must also say that all nano-groups performed better than metformin and were able to protect liver tissue as much as the control group. Magnesium oxide nanoparticles coated with hydroethanolic extract of olive figs were observed at 75, 150 and 300 mg/kg bleeding with cell necrosis as well as dilation of the central lobular vein space, but the best doses of gold were found in rat liver enzymes. Typically, doses of 75 and 150 mg/kg were coated in nanoparticles, which could reduce the activity of liver enzymes to some extent. They were even better than metformin, and metformin had little effect on reducing liver damage. Histopathological changes such as liver fibrosis, apoptosis and degradation of liver tissue to thioacetamide were observed in liver tissue. In other groups, the effects of bleeding in the central veins and lobules were less, but at a concentration of 300 kg/mg of coated nanoparticles, we observed high bleeding effects. Therefore, the safest dose of coated nanoparticles to protect liver tissue was 75 kg/mg.

ACKNOWLEDGEMENT

The authors are grateful to Department of Biology, Faculty of Basic Sciences, Islamic Azad University, Falavarjan Branch for their cooperation and supplying the experimental equipment.

REFRENCES

[1] Talebi, M., Amiri, Gh.R., Doudi, M. (2020). Antibacterial effect assessment of ZnO nanoparticles, ZnO:Fe nanoflower and Magnetic Fields, Int. J.

Bio-Inorg Hybrid Nanomater., 9(3), 131-13.

[2] Hoseyni Dowlatababdi, F., Amiri, Gh.R., Mohammadi Sichani, M. (2017). Investigation of the antimicrobial effect of silver doped Zinc Oxide nanoparticles. Nanomed. J., 4(1), 50-54.

[3] Chan, W., Nie, S. (1998). Quantum Dot bioconjugates for ultrasensitive nonisotopic detection. Science, 281, 2016-2018.

[4] Amiri, Gh.R., Yousefi, M.H., Aboulhassani, M.R., Keshavarz, M.H., Shahbazi, D., Fatahian, S., Alahi, M. (2010). Radar absorption of nanoparticles. Dig. J. Nanomater. Biostructures, 5(3), 1025.

[5] Monsef Khosh-hesab Z. (2011). Synthesis of ZnO nanoparticles using chemical deposition method. Int. Nano Lett., 1(4), 39-49.

[6] Amiri, Gh.R., Yousefi, M.H., Aboulhassani, M.R., Keshavarz, M.H., Manouchehri, S., Fatahian, S. (2011). Magnetic properties and microwave absorption in Ni–Zn and Mn–Zn ferrite nanoparticles synthesized by low-temperature solid-state reaction. J. Magn. Magn. Mater, 323, 730.

[7] Abugomaa, A., Elbadawy, M. (2020). Olive leaf extract modulates glycerol-induced kidney and liver damage in rats. Environ. Sci. Pollut. Res., 27(17), 22100-22111.

[8] Arnold, L., (2013). Random dynamical systems. Springer Science & Business Media.

[9] Ashok, C.H., Rao, K.V., Chakra, C.H.S., Rao, K.G. (2016). MgO Nanoparticles Prepared By Microwave-Irradiation Technique and Its Seed Germination Application. Nano Trends. J. Nanotechnol. Appl., 18(1), 10-17.

[10] Bian, H., Hakkarainen, A., Zhou, Y., Lundbom, N., Olkkonen, V.M. and Yki-Jarvinen, H. (2014). Impact of NAFLD on liver volume in humans. Hepatol Res., 45(2), 210-9.

[11] Brunt, E.M. (2011). Non-alcoholic fatty liver disease: what's new under the microscope? Gut, 60, 1152-1158.

[12] Chen, S.S., (2008). Attenuation of oxidative stress after varicocelectomy in subfertile patients with varicocele. J. urol., 179, 639-642.

[13] Cobbold, J.F., Anstee, Q.M. and Taylor-Robinson, S.D. (2010). The importance of fatty liver disease in clinical practice. Proc. Nutr. Soc., 69, 518-527.

[14] Cobbold, J.F., Anstee, Q.M., Goldin, R.D., Williams, H.R., Matthews, H.C., North, B.V., Absalom, N., Thomas, H.C., Thursz, M.R., Cox, R.D., Taylor-Robinson, S.D. and Cox, I.J. (2009). Phenotyping murine models of non-alcoholic fatty liver disease through metabolic profiling of intact liver tissue. Clin Sci. (Lond), 116, 403-413.

[15] Alhtheal, D., Radhy, A.M., Hasan, M.S., Kareem, M.H., Naje Saleh, E. (2020). Therapeutic Effects of Olive Oil on Rabbit with Lead Toxicity. Int. J. Pharm. Res., 12(1), 1-3.

AUTHOR (S) BIOSKETCHES

Maryam Nasr esfahani, Master of Biology, Falavarjan Branch, Islamic Azad University, Isfahan, Iran

Gholamreza Amiri, Associate Professor of Physics, Falavarjan Branch, Islamic Azad University, Isfahan, Iran, *Email: amiri@iaufala.ac.ir, amiri.nano@gmail.com*

Nooshin Naghsh, Associate Professor of Physics, Falavarjan Branch, Islamic Azad University, Isfahan, Iran