International Journal of Thin Films Science and Technology

http://dx.doi.org/10.18576/ijtfst/130311

Studying the Effect of Radiation Emitted from Mobile Phones and Home Routers on D3 and Calcium Levels in Rabbits

R. D. Mahdia[1,*] *and A. R. Mathloom*[1].

[1] Department of Physics, College of Education Pure Sciences, University of Thi-Qar, Nasiriyah, Iraq.

Received: 18 July. 2024, Revised: 6 Aug. 2024, Accepted: 20 Aug. 2024
Published online: 1 Sep. 2024

Abstract: The environment surrounding humans and animals has effects related to the level of exchange (affecting and influencing the surroundings) within its biological range, and our topic is related to the effect of radiation emitted from mobile phones and home routers on the biological composition of living organisms and their ability to change important vital functions. The study included determining the effects of radiation on D3 and calcium levels in rabbits when exposed for three months. From the results of the current study, there is an effect of the fields produced by these devices, based on the results of the statistical analysis of results reached in this study, there are significant effects on the numerically studied parameters, of the study (increase or decrease), as D3 levels decreased with the period and their highest value was represented by the control group and both groups, while calcium levels led to a clear significant difference through a clear increase in the calcium value compared to the control group and during the study periods and both groups, as their highest value was in the third month of the study.

Keywords: Calcium, D3, Electromagnetic Radiation, Mobile Phone, Router.

1 Introduction

The impact of radiation emitted by mobile phones and home routers is a prominent and concerning issue for specialists, intellectuals, and the general public alike. This topic is directly tied to the rapid advancements in information and communication technology, which have led to a surge in the use of technology systems emitting electromagnetic radiation (EMR). These systems, increasingly prevalent in the modern world, include satellite broadcasting, radar systems, radio and television broadcasting stations, wireless networks, industrial and medical applications, household microwave ovens, and mobile phones. Given the high levels of exposure to these radiations, it is essential to raise awareness of the need to study the rates of absorption and diffusion of these radiation within the tissues and cells of living organisms and to assess potential repercussions.

Although technology offers many benefits, excessive or improper use can bring negative effects. Scientific research into the effect of electromagnetic radiation on living organisms has increased significantly in recent decades [1]. Disruptive variables, such as electromagnetic radiation, can influence physiological parameters that create oxidants and antioxidants. Substantial research has examined the association between EMF exposure and several serious conditions, such as amyotrophic lateral sclerosis (ALS), pediatric leukemia, adult brain cancer, and miscarriage [2]. The interaction of electromagnetic fields with biological systems depends on factors such as frequency, amplitude, wavelength, and polarization [3]. Increased exposure to electromagnetic fields can affect cellular function by producing reactive oxygen species (ROS) [4].

As the number of mobile phone users continues to grow, reaching approximately five billion in 2011, the public's concerns about the health effects of electromagnetic fields (EMF) emitted by these devices on living organisms are also rising. This topic has gained significant importance in scientific research [2]. Given the widespread use of cell phones, medical researchers worry that even minimal health risks associated with them could have a considerable public health impact [5]. The Global System for Mobile Communications (GSM) 2G mobile phone technology operates at frequencies up to 900 MHz and 1800 MHz and offers limited data transfer speeds of up to 88 Kb/s for activities such as SMS, photos, and internet browsing.

The extensive use of routers has similarly increased individuals' exposure to electromagnetic radiation in public spaces, though this technology has greatly improved daily life. Routers connect two or more packet-switched networks or subnetworks at frequencies ranging from 2.4 to 5 GHz [6] and perform two main functions: managing traffic between networks by directing data packets to targeted IP addresses and allowing multiple devices to share the same internet connection. While there are several types of routers, most transfer data between local area networks (LAN) and wide area networks (WAN) [7].

Bone health is an essential component of overall well-being, with calcium and vitamin D playing critical roles in maintaining bone strength and density. Calcium is the

*Corresponding author E-mail: rusuldhiab.Phsx@utq.edu.iq

primary element that forms bone structure, with about 99% of it stored in the bones and teeth to support skeletal integrity and protect against fractures [8]. The remaining 1% of calcium is found in blood and body tissues, where it serves other vital functions. Vitamin D, on the other hand, facilitates calcium absorption from the intestine, and without adequate levels of vitamin D [9], the body can absorb only a small portion of the dietary calcium. Therefore, for healthy bones, sufficient intake of both calcium and vitamin D is essential to ensure bones remain strong and resilient.

Electromagnetic waves can impact bone health differently depending on frequency, intensity, and exposure duration. Some studies suggest that low-frequency electromagnetic fields, such as those used in specific medical treatments, may promote bone healing and growth, and are thus used to treat bone fractures, osteoporosis, and other bone-related conditions. In contrast, prolonged or intense exposure to higher frequencies, such as those emitted by cell phones and Wi-Fi devices, has raised concerns about potential health effects. However, current evidence indicates that typical exposure levels do not significantly impact bone health [10], though research is ongoing to evaluate long-term effects.

The aim of this study was to examine the impact of electromagnetic radiation from mobile phones and routers on vitamin D3 and calcium levels in laboratory rabbits, to assess potential implications for osteoporosis. The goal is to provide data and recommendations to safeguard citizens against radiation risks, tailored to current realities.

2 Materials and Methods

2.1 Experimental animals

This experiment involved 24 local adult male rabbits, with average weights ranging from 1900 to 2400 grams and ages between 6 and 8 months. They were housed in the animal facility at the College of Education for Pure Sciences, Thi-Qar University, in designated rabbit cages. Cage floors were lined with sawdust, which was regularly cleaned and sterilized. Clean water bottles were provided, and the rabbits' shelter room was kept sanitary. The rabbits were maintained under appropriate laboratory conditions, with a temperature range of 22-25°C and a 12-hour light-dark cycle. During the trial, they were fed a water and feed composition as specified in [11], along with vegetables like carrots. Each animal was screened to ensure it was healthy and disease-free before the experiment. They were then given a 14-day acclimatization period to adjust to the controlled laboratory environment, which included stable temperature, light, and ventilation. All animals remained in the same location and setup throughout the experiment.

2.2 Experiment design

The rabbits were randomly divided into three groups, each containing 8 animals. The first group served as the control, while the second and third groups were used to assess D3 and calcium levels following exposure to mobile phone and router radiation, respectively. After completing the acclimatization period, a mobile phone or router was placed on top of each group's cage for three months, with an average exposure of 22 hours per day. The phone or router was positioned 35 cm away from the rabbits, in a box measuring 75 cm in length, 30 cm in height, and 60 cm in width. The device was mounted on the top of the box, maintaining a consistent distance from the animals. This setup is shown in Figure 1.

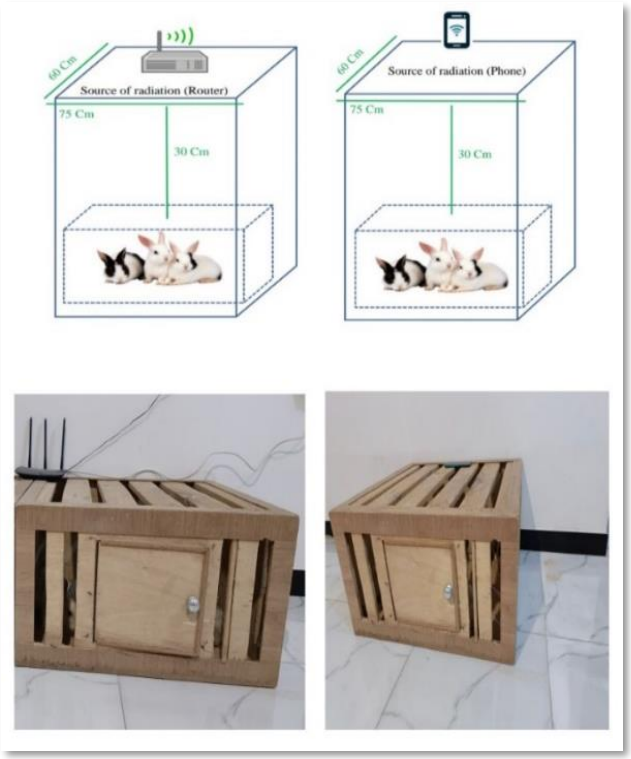

Fig. 1: shows a diagram of the animal exposure process for both the mobile phone and the router

2.3 Blood Collection and Measurements

After 30 days of exposure, blood samples were taken using 5ml medical syringes, either by puncturing the heart or the ear After 2.5 ml of blood were added to vacuum tubes containing gel and allowed to coagulate for an hour, the serum was separated in a centrifuge running at 3500 rpm for (3-5) minutes. The serum is also stored in small plastic tubes at a temperature of (-20 degrees Celsius) until the test is performed (measurements of calcium and D3 levels), where These steps are repeated after 60 days in the same manner used to preserve blood samples. After the end of the 90-day experiment, animals were slaughtered directly and blood was drawn from the heart directly after anesthetizing them with chloroform by placing a specific amount of this substance in the rabbits inside a glass container with a tight cover, where fine pins were used to secure its front and rear ends.

2.4 Statistical analysis

The statistical program (SPSS) was used to statistically analyze the results obtained in this study, and (Paired-Samples T-test) analysis was used to calculate the difference between samples. All values are represented as the mean ± standard line (SE). Significant results were considered at the probability level $p<0.05$, and SPSS version 0.23 was used.

3 Results and discussion

The results show the average values of vitamin D3 and calcium levels in animals exposed and not exposed to mobile phone waves and routers (Figures2, 3, 4, 5). A significant decrease was observed in proportion to the exposure period (3 months) compared to the control group, and these results were statistically significant ($P<0.05$).

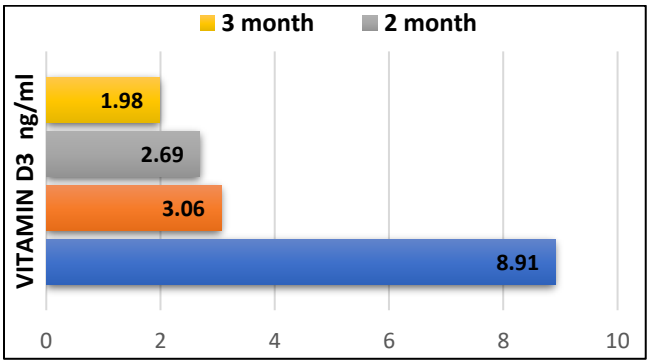

Fig. 2: D3 levels for Mobile Phone Exposure

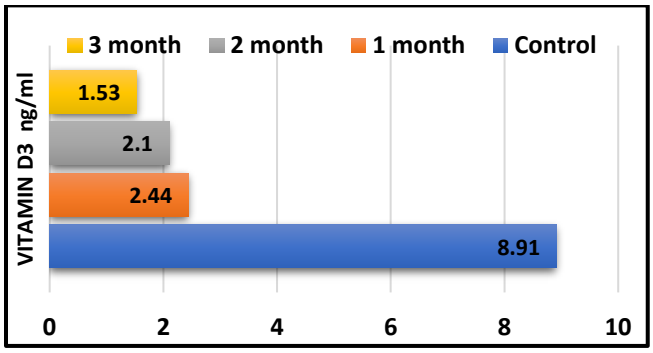

Fig. 3: D3 levels of exposure to the Router

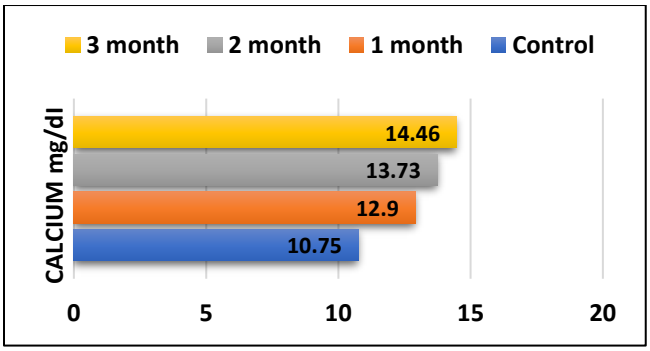

Fig. 4: Calcium levels for exposure to a Mobile Phone

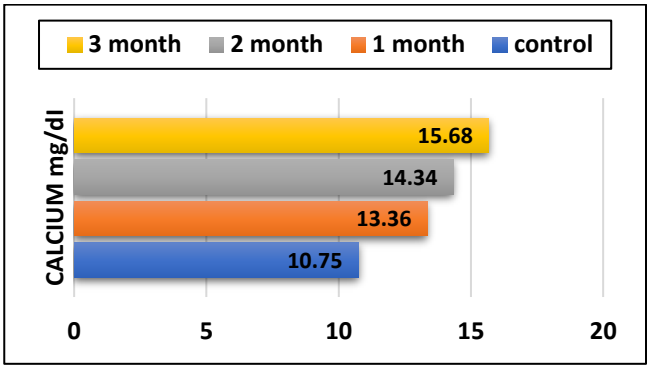

Fig. 5: Calcium levels for exposure to the Router

Table 1: Shows the values of both D3 and calcium after exposure to radiation emitted from Mobile Phones and Router

Exposure period	Vitamin D3 levels		Calcium levels	
	Router	Mobile Phone	Router	Mobile Phone
Control group	8.91		10.75	
1 Month	2.44	3.06	13.36	12.9
2 Month	2.1	2.69	14.34	13.73
3 Month	1.98	1.53	15.68	14.46

Figures 2 and 3 show that there is a statistical significance at the probability level $p<0.05$ in the studied samples for all exposure periods (first month, second month, and third month) when exposed to mobile phones and routers, and there is a significant difference in D3 levels compared to the control group. It is noted, as in Figure 2, that the blue line represents the average of the control group, as it starts with a relatively high level compared to the other months, then decreases significantly until the D3 value in the third month reaches 1.98 ng/ml. likewise, this decrease in D3 levels was observed with exposure to the router, as shown in Figure 3, until it reached 1.53 ng/ml. This indicates a significant effect of the radiation emitted from these devices on D3 levels with increasing exposure duration.

The decrease in vitamin D3 levels may be due to the effect of the emitted radiation, as the decrease was observed to be greater in the group exposed to the router compared to the group exposed to the mobile phone. This confirms that the energy absorbed in different layers of body tissues from electromagnetic waves depends on the conductivity of the tissues, where at low frequencies the resistive value of the tissues is very high (in other words, low tissue conductivity).

In addition, the frequency of the incident wave, an increase in frequency leads to an increase in the relative heating of body tissues [12], which corresponds to the results of our study.

The results shown in figures (4, 5) indicate that there are significant differences in calcium levels for all exposure months compared to the control group. This suggests that there is a clear effect of radiation emitted from the mobile phone and directed at increasing the calcium levels index,

reaching a ratio of 14.46 mg/dL during exposure to the phone in the third month, as shown in figure 4, while the calcium value in the third month was 15.68 mg/dL during exposure to the directed radiation, as shown in figure 5.

High levels of calcium are not associated with a deficiency of vitamin D, as this contradicts the role of vitamin D in enhancing calcium absorption from the intestines. Therefore, high calcium levels are attributed to another cause unrelated to vitamin D, which is hyperactivity of the parathyroid gland, where the parathyroid glands become more active and produce more PTH hormone (PTH hormone is produced by the parathyroid glands located behind the thyroid gland, responsible for regulating calcium and phosphorus levels in the blood and bones), leading to the release of calcium from the bones into the bloodstream, as shown in figures (4, 5), which is consistent with study [13].

4 Conclusions

We conclude from this study that there is an effect of radiation emitted from the mobile phone and the home router on D3 levels and calcium levels, and this effect in the opposite direction, as D3 level decreases during study period, corresponding to an increase in calcium levels for both mobile phone and router, and this indicates to presence of a clear effect that leads to a change and an increase in vulnerability to fragility and softening of bones, thus weakening bones if problem continues untreated for a long period time.

References

[1] A. Aziz, " *Measurement of the Concentration of Radioactive Materials in Water and Sediments from Tigris River by Gamma Ray Spectroscopy*" , college of Science of Bagdad Univ. Iraq. (2002)

[2] Ahmed R. Mathloom,AbdulbariA.Alfaris & ZekiA.Ahmed, "Calculation of the Specific Absorption Rate (SAR) and Absorption Ratio of the Thyroid Gland in Rabbits at the Frequencies (9, 10.5, 12) GH_Z", "*1st International Conference on Advanced Research in Pure and Applied Science*", which will be held at College of Science / Al- Muthanna University, Iraq during 24-25 March, 2021. Your paper will be published online by AIP Conference Proceedings (ISSN: 0094-243X).

[3] European Commission. Scientific Committee on Emerging and Newly Identified Health Risks (*SCENIHR*), (2007).

[4] S. Sivani and D. Sudarsanam, Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem—a review, *Biol Med.* **4**(2012), 202-2016.

[5] A. Torkan, "*Examining changes in sensitivity and functionality of mechanosensitive ion channel protein Piezo 1 exposed to low-level radiofrequency radiation*," RMIT University, (2021).

[6] S. J. Beasley, N, Piyawat, "A Practical Guide to Advanced Networking" *Pearson Education*. USA. (2012)

[7] H. A. AL-Moudares, Electromagnetic pollution, Central organization for standardization and quality control/ metrology department, **2**(2010), 20-33.

[8] K. Chang S. Huang, C. Shih. Pulsed electromagnetic fields stimulation affects osteoclast formation by modulation of osteoprotegerin, RANK ligand and macrophage colony-stimulating factor, *J Orthopaedic Res*. **23**(2005), 1308–1314,

[9] P. Manoj, R. Derwin, S. George, What is the impact of daily oral supplementation of vitamin D3 (Cholecalciferol) plus calcium on the incidence of hip fracture in older people? A systematic review and meta-analysis, *Int J Older People Nurs.* **18**(2023) e12492, doi: http://doi.10.1111/opn.12492.

[10] Y. Xu, P. Dong, A. Wang, J. Hou, and Sh. Li, A Quad-Band high-Isolated MIMO Microstrip Antenna for Coal Mine Communication , Progress In Electromagnetics Research Letters **115**(2023) 39-46

[11] M. N. od AL-Shemary , "*Effect of Honey in Some Physiological, Histological Parameters in Male Rabbits which Exposed to X-rays*" , Kerbala University, Iraq, (2018).

[12] R. Ahmed Mathloom et al , "Measurement of the Dielectric Constant and loss Tangent of Polyester / Walnut Shells by the Cavity Perturbation Method at the Microwave X-band Frequencies", *NeuroQuantology* **19**(2021), 26-31, doi: 10.14704/nq.2021.19.3.NQ21024.

[13] K. Chen, Y. Xie, L. Zhao, Medicine Hyperthyroidism-associated hypercalcemic crisis, (*Baltimore*) **96**(2017) e6017. doi: https/doi.10.1097/MD.0000000000006017.