

Assessment of the Cellphone Radiations Effects on Anti-oxidative and Renal Parameters in Rat

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Abstract

Objective: In the present study an attempt is to assess the cellphones waves effects on the stress oxidative activities as well as renal parameters in rat.

Methods: 30 mature male Wister rats were divided into 3 groups of 10. Group 1 (control) was kept in normal laboratory conditions. Groups 2 and 3 were exposed with two and four cellphones in opposite sides of the cage, respectively. Blood samples were collected directly from the rat's heart 15 and 30 days post exposure and the activity of anti-oxidative factors including Glutathione Peroxidase, Superoxide Dismutase, Catalase, Glutathione Peroxidase, Paraoxonase and Malondialdehyde as well as renal parameters (Urea, Uric acid and Creatinine) were measured.

Results: Activity of catalase, superoxide dismutase and paraoxonase enzymes in all treated groups, 15 and 30 days post cellphone exposure were significantly increased in comparison with control. The activity of glutathione peroxidase enzyme in all treated groups, 15 and 30 days post cellphone exposure was decreased in comparison with control. Malondialdehyde and creatinine activity did not show any significant changes. Uric acid and urea were significantly increased in the group just exposed with four cellphones, 30 days post exposure.

Conclusion: According to the results, many changes were seen in biochemical parameters due to the cellphone exposure during a month. Therefore it can be concluded that radio frequency devices could be destructive and have many negative effects on the tis-

sues and enzyme function.

Keywords: Cell phone, Antioxidant, Oxidative, Rat, Biochemical parameters

Introduction

The radio frequency (RF) part of the electromagnetic spectrum consists of the frequencies range from 3 KHz to 300 GHz. RF waves are used in many applications such as radio communications, TV, internet, wireless phones, cellphones, GPS (Global Positioning System), satellite communications, home microwave ovens, radar and medical usages^{1,2}. Electromagnetic fields with microwave and radio frequencies provide a good tool for understanding biological, molecular, natural growth, immune responses and the process of cell-to-cell communications³. Scientists and physicians have named some concerns about the likelihood of dangers raised by electromagnetic fields exposure^{4,5}.

Nowadays cellphones are one of the common instruments radiating electromagnetic waves that are easily available for more than half of the people in the world on various ages. Expanding cellphone networks and variety of services offered by the servants of these networks like SMS (Short Message Service), MMS (Multimedia Message Service), audio calls, video calls and electronic pay, have made them popular⁶. Electromagnetic waves penetrate to the body and the cell membrane and also distribute the ions and bipolar among the cell parts. These changes can affect biochemical processes in cells⁷. In recent decades some studies have been done on the influences of electromagnetic fields over cellular, molecular stress, oxygenic reactive ROS (Reactive Oxygen Species) and free radicals⁸. The waves radiated from cellphone device consist of a vast range of invisible electromagnetic waves that are radiated from radar microwave. The frequency range of cellphone devices is 900-1100 MHz and as the microwave oven that make the food warm, cellphone can produce heat impact too and penetrate up to 3 cm into the brain^{9,10}. These waves do not pass into relatively thick bones, however in kids can penetrate into brain cortex and therefore using cellphone is more dangerous for kids¹¹. Regarding to the increasing usage of

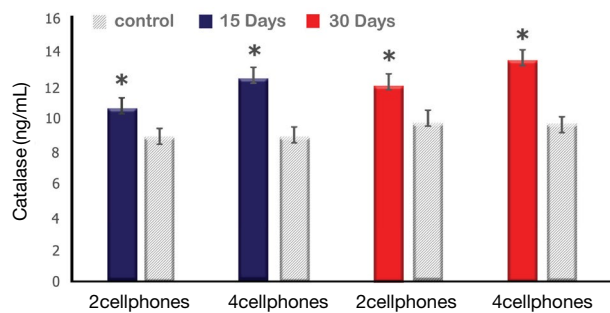


Figure 1. Catalase activity of all groups 15 and 30 days post exposure.

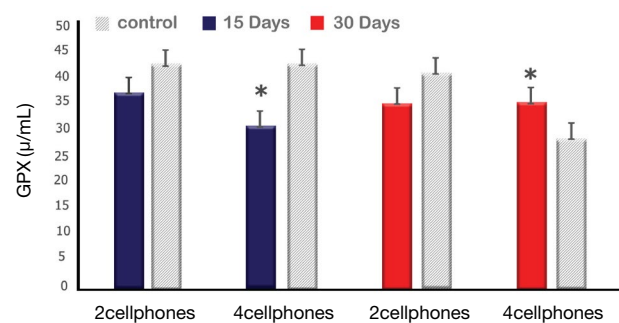


Figure 3. GPX activity of all groups 15 and 30 days post exposure.

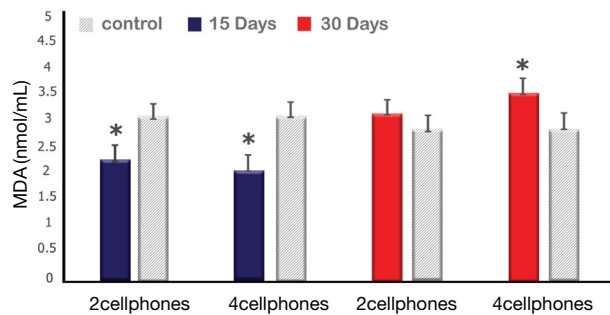


Figure 2. MDA activity of all groups 15 and 30 days post exposure.

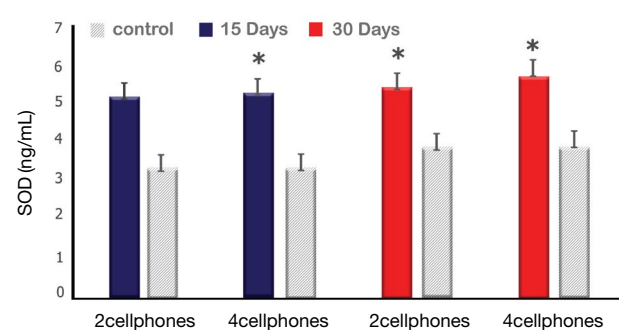


Figure 4. SOD activity of all groups 15 and 30 days post exposure.

cell phones, it seems that assessment of cell phones effects on human's health is necessary.

In this assay an attempt is to survey the cellphones waves effects on the stress oxidative activities (Glutathione Peroxidase, Superoxide Dismutase, Catalase, Glutathione Peroxidase, Paraonase and Malondialdehyde) as well as renal parameters (Urea, Uric acid and Creatinine) in rat.

Results and Discussion

Figure 1 shows the activity of catalase enzyme for all groups 15 and 30 days post exposure with cell phone waves. Group that has meaningful differences in comparison with control is marked with star (p value ≤ 0.05). According to the Figure 1, it is observed that catalase level is increased in all treated groups in comparison with control. It is also can be seen that the activity of catalase for the group exposed with four cell phones is more than that of exposed with two cell phones.

Kesari *et al.* (2011) in their study reported that exposure of 900 MHz radiation significantly increases the

catalase enzymatic activity in liver, brain and sperm of male Wistar rats. It is in a good agreement with the data obtained from this research¹².

Figure 2 indicates the level of MDA for all groups 15 and 30 days post exposure. As can be seen, the level of MDA has not shown any significant changes in all groups.

Canseven *et al.* (2008) have studied the effects of the electromagnetic field on the heart and liver tissue of Guinea pigs exposed (50 Hz) for 4 and 8 hours during 5 days. According to the intensity and duration of radiation, changes in the levels of MDA and GPX activity and also the formation of free radicals were measured¹³.

The activity of GPX is shown in Figure 3 for all groups 15 and 30 days post exposure. It can be seen that, the level of GPX activity in the groups exposed with four cellphones is significantly decreased in comparison with control.

Ozgeur *et al.* (2007) have investigated the effects of cellphone radiations and realized that along with the production of free radicals reduced the activity of antioxidant enzymes (Catalase, SOD, GPX) and ultimately decreased the antioxidant capacity of the cells¹⁴.

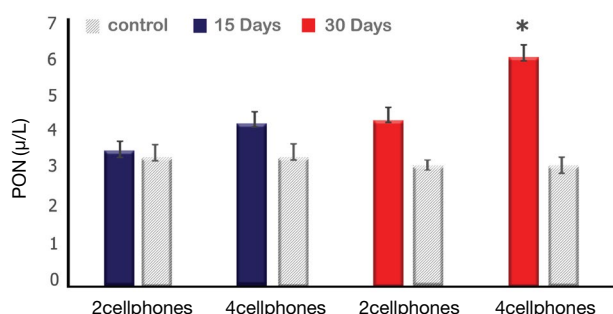


Figure 5. Paraoxonase activity of all groups 15 and 30 days post exposure.

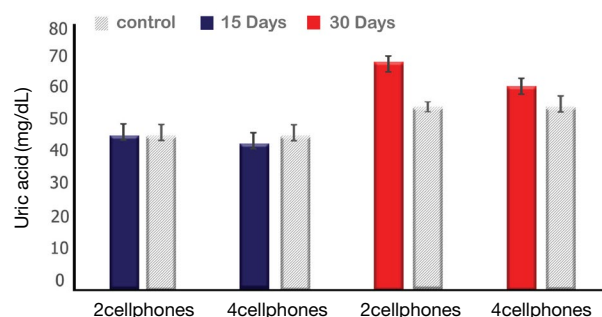


Figure 7. Uric acid level of all groups 15 and 30 days post exposure.

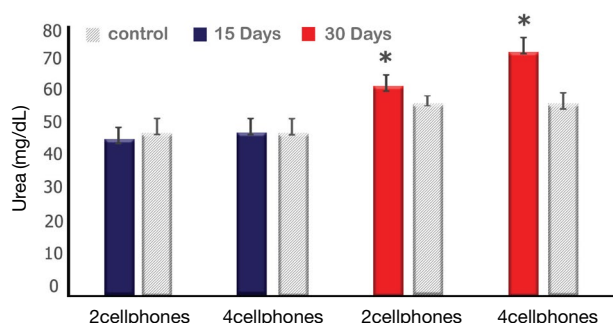


Figure 6. Urea level of all groups 15 and 30 days post exposure.

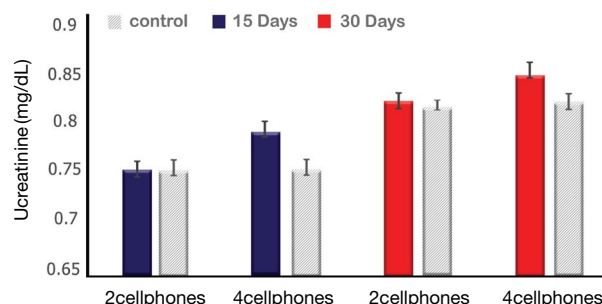


Figure 8. Creatinine level of all groups 15 and 30 days post exposure.

Kesari *et al.* (2011) in their study showed a decrease in the GPX activity in the brain of male Wistar rats exposed to 900 MHz radiation, which is in a good agreement with the results of the current study¹².

Figure 4 demonstrates the mean SOD activity for all groups 15 and 30 days post exposure. From the figure it is obvious that SOD activity in all treated groups is significantly increased in comparison with control.

Awad *et al.* (2008), in a study on the health hazards of mobile electromagnetic radiations on the brain of rats indicated that the antioxidant enzymes activity (defining the antioxidant status) in the exposed groups were lower than that of control group. In other words, the GPX and catalase activities were reduced, while increased oxidative effects may increase SOD activity¹⁵.

The mean activities of paraoxonase in all groups are shown in Figure 5. As can be seen, there is a meaningful increase in the group exposed with four mobiles during 30 days. Other groups have not shown any meaningful differences in comparison with control.

Figure 6 illustrates the urea average in all groups, 15 and 30 days post exposure. Based on the observed dia-

gram, there is a meaningful increase in the group exposed with four mobile 30 days post exposure in comparison with control. Other groups have not shown any significant changes.

Asgari *et al.* (2014) reported that electromagnetic radiations emitted from mobile phones cause a dramatic increase in urea and creatinine levels. Ultimately, the electromagnetic field emitted from the mobile phones could cause changes in many biochemical parameters and impose oxidative stress in brain, as well as liver and kidney tissues. In the current study, an increase was observed in the amount of urea in the four-mobile group 30 days post exposure, which is consistent with the results of Asgari *et al.*¹⁶.

The mean values of the uric acid for all groups are demonstrated in Figure 7. As shown, the uric acid mean value is increased just in the group exposed with four mobile 30 days post exposure. Other groups have not shown any significant changes.

Lotfi (2011) in a study evaluated the effects of electromagnetic radiation especially RF waves emitted from mobile phones, on some serum and histological parameters of a number of organs in mice exposed to short- and long-term doses (15 and 30 days, respec-

tively). He reported that exposure could dramatically increases the level of testosterone, creatinine, urea, and uric acid in both groups (15 and 30 days). Our results are in the good agreement with that of Lotfi¹⁷.

The results of the study in creatinine levels in the present study which are shown in Figure 8 have not demonstrated any significant changes in any groups, 15 and 30 days post exposure.

Materials and Methods

Cellphones and Animal Groups

In this study, 30 mature male Wistar rats (300 to 350 g) were prepared from Falavarjan University animal house. They were kept at 25°C, 12 hours day light and 12 hours darkness. They accessed to water and food freely. They were divided randomly to 3 groups of 10 (each group in separate cage). Group 1 which was named control, was kept in normal circumstances of laboratory. Groups 2 and 3 which were named treated groups, were exposed with two and four cell phones, respectively (cellphones were hanged on their cages wall). The cell phones were called 15 times a day and every call was lasted 10 minutes. Blood samples were taken 15 and 30 days post exposure directly from the heart of rats (each time 5 rats from each group were sacrificed).

In this study, several types of cellphone device models including “Nokia N97 (850-1800 MHz), Nokia 108 and 1100 (900-1800 MHz), Samsung S5660 (850-1900 MHz), Sony Ericsson K750 and Sony Ericsson G900 (900-1900 MHz)” were used.

Measurement of the Anti-oxidative and Renal Parameters

In this study, the catalase activity was measured based on dichromate method in acetic acid where Sinha was reduced into chromic acetate. Then, the concentration of the produced chromic acetate was measured at 570 nm¹⁸.

In order to measure GPX (glutathione peroxidase), the rat glutathione peroxidase (GSH-PX) Elisa kit was used. The base of this kit is the Eastbiopharm technique from double sandwich Antibody Company for determining the levels of rats' GPX activity¹⁸.

For measuring SOD (superoxide dismutase), purple kit from Zellbio Company was used. The basis of the kit is turning anion superoxide into hydrogen peroxide and oxygen under condition of enzyme reaction. The final product of reaction is a colorful chromogenic solution and the calorimetric measurement method with 420 nm wave length was used¹⁸.

For measuring MDA (Malondialdehyde), the kit

from Zellbio Company was used. This kit works based on the absorption in 535 nm calorimetric measurement. The measurement was performed through the interaction of MDA and Thiobarbituric acid under high temperature condition. MDA was measured at acidic environment and 90-100°C using the calorimetric method (450-535 nm)¹⁸.

PON (Paraoxonase) measurement kit was purchased from Taligene Pars Company which indicates the paraoxonase activity using only one indicator. In this method, paraoxonase catalyzes paraoxon, resulting in paranitrophenyl. The level of paranitrophenyl production was calculated by measuring the increased absorption in 412 nm wavelength at 25°C¹⁹.

Renal factors (Urea, Creatinine and Uric acid) were measured using alpha classic auto-analyzer.

Statistical Analysis Method

The comparison of the averages of various factors between cellphone exposed and control groups were performed using ANOVA (Analysis of Variance) and in case of significance differences ($p < 0.05$), the comparisons was performed using Duncan's test. Also, the significant or insignificant differences between the groups were examined two-by-two by LSD test. All of the analyses were done by SPSS-18 software.

Conclusion

According to the results of the present research, many changes were seen in biochemical parameters due to the cellphone exposure during a month. Therefore it can be concluded that radio frequency devices could be destructive and have many negative effects on the tissues and enzyme functions (especially kidney function and enzymatic system). It is also should be mentioned that it is better to study the effects of mobile radiations during a longer period of time (more than a month).

Conflict of Interest

Elham Eslami declares that she has no conflicts of interest. Soheil Fatahian declares that he has no conflicts of interest. Kahin Shahanipoor declares that she has no conflicts of interest.

Ethical Approval

The animals used in the study are ethically approved by Animal Welfare Division, issued by Islamic Azad

University, Iran (ref no.: IR.IAU.NAJAFABAD.REC.1397.015).

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References

- Hardell, L. & Sage, C. Biological Effects from Electromagnetic Field Exposure and Public Exposure Standards. *Biomed. Pharmacother.* **62**, 104-109 (2008).
- Ryu, J.-C. & Ahn, J.-Y. Special Issue: Abstracts of the 10th International Conference on Environmental Health Science. *Toxicol. Environ. Health Sci.* **9**, 1-81 (2017).
- Parivar, K., Nabini, M., Golestanian, N. & Amini, E. Effect of Low Frequency Electromagnetic Fields on the Spermatogenesis and Blood Serum Protein of Balb/c Mice. *J. Cell & Tissue.* **2**, 47-56 (2011).
- Neužilová, B., Ondrák, L., Čuba, V. & Múčka, V. Influence of the Dose Rate of Gamma Irradiation and Some Other Conditions on the Radiation Protection of Microbial Cells by Scavenging of OH Radicals. *J. Radioanal. Nucl. Chem.* **318**, 2449-2453 (2018).
- Múčka, V., Červenák, J., Čuba, V. & Bláha, P. Determination of the Survival of Yeast and Bacteria Under the Influence of Gamma or UV Radiation in the Presence of Some Scavengers of OH Radicals. *J. Radioanal. Nucl. Chem.* **304**, 237-244 (2015).
- Khadrawy, K. H., Ahmed, N., Aboulezz, H. & Radwan, N. M. Effect of Electromagnetic Radiation From Mobile Phone on the Levels of Cortical Amino Acid Neurotransmitters in Adult and Young Rats. *Romanian J. Biophys.* **19**, 295-305 (2009).
- Lee, J. S., Ahn, S. S., Jung, K. C., Kim, Y. W. & Lee, S. K. Effects of 60Hz Electromagnetic Field Exposure on Testicular Germ Cell Apoptosis in Mice. *Asian J. Androl.* **6**, 29-34 (2004).
- Gharamaleki, H., Soleimani, R. J., Roshangar, L., Vatanhah, A. M. & Valipour, A. Effect of Extremely Low-frequency Electromagnetic Field Exposure on Biomarkers of Oxidative Stress in Pregnant Rats. *J. Laboratory & Diagnosis* **6**, 31-35 (2014).
- Ireland, D. & Abbosh, A. Modeling Human at Microwave Frequencies Using Optimized Debye Models and FDTD Method. *IEEE. Transactions on Antennas and Propagation* **61**, 2352-2355 (2013).
- Lazebnik, M., Okoniewski, M., Booske, J. H. & Hagness, S. C. Highly Accurate Debye Models for Normal and Malignant Breast Tissue Dielectric Properties at Microwave Frequencies, *IEEE. Microwave and Wireless Components Lett.* **17**, 822-824 (2007).
- Frey, A. H. Electromagnetic Field Interaction with Biological Systems. *FASEB. J.* **7**, 272-281 (1993).
- Kesari, K. K., Kumar, S. & Behari, J. 900-MHz Microwave Radiation Promotes Oxidation in Rat Brain. *Electromag. Biology Med.* **30**, 19-34 (2011).
- Canseven, A. G., Coskun, S. & Seyhan, N. Effects of Various Extremely low Frequency Magnetic Fields on the Free Radical Processes, Natural Antioxidant System and Respiratory Burst System Activities in the Heart and Liver Tissues. *Indian J. Biochem & Biophys.* **45**, 326-331 (2008).
- Ozgur, E., Öytürk, G. G. & Seyhan, N. Regenerative Effects of (-)-epigallocatechin-gallate Against Hepatic Oxidative Stress Resulted by Mobile Phone Exposure. *11th Mediterranean Con. Med. Biomed. Eng. Comput.* **16**, 214-217 (2007).
- Awad, S. M. & Hassan, N. S. Health Risks of Electromagnetic Radiation from Mobile Phone on Brain of Rat. *J. Appl. Sci. Res.* **4**, 1994 -2000 (2008).
- Asgari, M., Ahmadi, R. & Gohari, A. The Effects of Mobile Phone Radiation on Serum Levels of Creatinine in Male Rats. *Int. Con. Earth, Environ. Life Sci.* 23-24, Dubai (2014).
- Lotfi, S. A. Effect of Electromagnetic Radiation Emitted from a Mobile Phone Station on Biochemical and Histological Structure of Some Rat Organs. *Isotope & Radia. Res.* **43**, 95-103 (2011).
- Hangzhou Eastbiopharm Co., LTD. http://www.eastbiopharm.com/english/Products_list_8 (2009).
- Taligene Pars Co., ISTT. <http://taligene.com/?lang=en> (2011).