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RESEARCH ARTICLE

STUDY OF HARMFUL EFFECTS OF LOW FREQUENCY RADIATION OF CRT TV/ PC SCREEN ON HUMAN BLOOD TISSUES

Vijay Kumar¹, Anuj Tyagi² and P. P. Pathak^{*,3}

¹Department of Physics, Uttarakhand Graphic Era University, Dehradun (Uttarakhand) India

²Department of Physics, Graphic Era University, Dehradun (Uttarakhand) India

^{3,*}Department of Physics, Gurukula Kangri University, Haridwar (Uttarakhand) India

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ABSTRACT

Many recent studies have indicated that non-ionizing electromagnetic fields have an adverse health effects on human beings. This study evaluated the effects of low frequency electromagnetic field (LF - EMF) which is radiated by CRT TV/PC screen on blood cell of human beings. The data of incident fields are estimated by the magnetic fields which have been experimentally observed by W.T Kaune et al., (2000) and penetrated electric field & current density inside the blood cells are calculated. The estimated data are compared with the safety guidelines of different international agencies like International Commission of Non Ionizing Radiation Protection (ICNIRP) and World Health Organization (WHO). It is found that 50 cm distance and 90 cm height of CRT TV/PC screen is harmful for the life of blood tissues.

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INTRODUCTION

Now a days, the task of estimating the currents induced within the human body by environmental electromagnetic fields has received increased attention from scientists around the world. While important progress was made in this direction, the unpredictable behaviour of living biological tissue made it difficult to quantify its reaction to electromagnetic fields and has kept the problem open. A successful alternative to the very difficult one of performing measurements is that of computing the fields within a human body model using numerical methods implemented in a software code (Hoang *et al.*, 2009, Motrescu *et al.*, 2005). The BioInitiative Report is based on an international research and public policy initiative to give an overview of what is known of biological effects that occur at low-intensity electromagnetic fields (EMFs) exposure. Health endpoints reported to be associated with ELF and/or RF include childhood leukaemia, brain tumours, genotoxic effects, neurological effects and neurodegenerative diseases, immune system deregulation, allergic and inflammatory responses, breast cancer, miscarriage and some cardiovascular effects (Hardell and Sage 2008, Bernard 2008). To study the effects of radiation of CRT TV/PC screen, the normal healthy volunteers are assumed not to react to a CRT TV/PC screen provocation. The results might lay a foundation to understand the underlying cause of so-called "screen dermatitis" with special reference to mast cells. However, blind or double-blind experiments using patients ought to be further investigated in order to find out the exact cause for the observed changes. Such causes include the effects of surrounding airborne

chemicals, stress factors, etc. (Johansson 2001, Kumar 2010). The effects of continuous exposure of chick embryos and young chickens to the electromagnetic fields (EMFs) emitted by video display units (VDUs) and GSM cell phone radiation, either the whole spectrum emitted or attenuated by a copper gauze, were investigated. Permanent exposure to the EMFs radiated by a VDU was associated with significantly increased fetal loss (47–68%) and markedly depressed levels of circulating specific antibodies (IgG), corticosterone and melatonin, under chronic exposure conditions, GSM cell phone radiation was harmful to chick embryos, stressful for healthy mice and, in this species, synergistic with cancer insofar as it depleted stress hormones (Canova 2010, Bastide 2001). EMFs from TVs may be one of the biggest hazards in our home because children often love to sit very close to the TV, exposing themselves to a steady flow of harmful EMFs for hours. TV sets with larger screens tend to emit stronger fields because they contain larger cathode-ray tubes, the components that produce EMFs. In general, the larger the TV screen, the stronger the EMFs that are produced and the further away you need to be to get out of the range from electromagnetic fields. Blood is a main part of the human beings, thus the harmful effects of electromagnetic waves which are emitted from CRT TV/PC screen is studied for blood.

According to Peyman *et al.* (2010), the power densities around Wi-Fi devices are well within the ICNIRP reference level at distances of 0.5m and more, it is also important to consider the absorption of radio frequency energy in the body of a person near the devices. A parallel study shows the same result from

*Corresponding author: anuj_physics@hotmail.com

Wi-Fi equipment in models of adults and children (Findlay and Dimbylow 2010). The higher exposure of EMW of CRT TV/PC screen can disturb the normal functioning of RBC and WBC (Nadejde 2009).

MATERIALS AND METHODS

The magnitude of the electric field which produces by CRT TV/PC screen is very high and reduces with increase of the distance. The magnitude of electric field also depends upon the height of TV situated also. Higher is the environmental electric field; higher would be the penetrated depth across the tissues. This electric field produced current density in tissues which disturb the chemical reaction rate and normal functioning of the body tissues and results in many diseases (Kumar *et al.*, 2010).

When electromagnetic field penetrates into the human body, the electric field inside the body decreases exponentially with distance from the boundary and is given by –

$$E_i = E_0 \cdot \text{Exp}(-z/\delta) \text{-----} [1]$$

Where E_i is the field inside the depth z and E_0 is the magnitude of field just inside the boundary. The skin depth (δ) is the distance over which the field decreases to 0.368 of its value just inside the boundary. The skin depth (δ) again depends upon frequency of radiation.

Current density J induced in the Human Skin: In the low frequency range, the exposed object (human) is much smaller than the wavelength. At low frequencies (up to a few 100 kilohertz), the basic quantity is the current density J induced in the tissues and at higher frequencies the Specific Absorption Rate (SAR) is considered. Induced current density (J) calculated by using Ohm’s law as

$$J = \sigma E_i \text{-----} [2]$$

where E_i is the induced electric field inside the human skin (Kumar, 2010, Kumar *et al.*, 2010). For estimation of the electric field inside the body and the induced current density for blood tissue, skin depth & conductivity of the blood tissue are taken from Gabriel *et al.*, (1996).

Magnetic field: The effect of magnetic field very low than electric field, because the magnitude of magnetic field is very low in comparison to electric field as

$$B = E/c$$

where c is the velocity of radiation of CRT TV/PC screen. Thus this study is made only for the electric field of the radiation.

RESULTS AND DISCUSSION

The aim of this paper is to understand the distribution of electromagnetic field in human blood tissues with respect to various depth of human body. It is well known that an electric and magnetic field are induced around the CRT TV/PC screen. When a biological body is exposed to low frequency EMF, it’s penetrated inside the body. The CRT TV/PC screens are

radiated electromagnetic waves of frequencies of five ranges as (10-3066) Hz, (10-54) Hz, (54-606) Hz, (606-3066) Hz and 120Hz. In this study the TV set is situated at 50, 100, 175 and 250 cm away from the human body. The electric fields are also different at different height of the TV from the earth surface. In this study, the height of the TV is taken from 30, 60 and 90 cm from the earth surface. The penetrated electric fields inside the different depth of human body due to all ranges of the frequency of the radiation are shown in tables 1 to 5 respectively. Table 1 represents the geometric mean of penetrated electric field due to the frequency range (10-3066) Hz inside the different depth of human body. After penetration, the electric fields are different at different depth. The maximum electric fields are produced at 50 cm distance, 90 cm height and the minimum electric fields are produced when TV set is situated at 250 cm distance, 60 cm height from the earth.

Figure 1, 3 & 4 show that the electric field of frequency ranges (1, 3 & 4) radiated by CRT TV set produced maximum electric field at 50 cm distance, 90 cm height but frequency range 2 produced maximum electric field at 50 cm distance, 60 cm and 90 cm heights and table 5 shows that the maximum electric field at 50 cm distance, 60 cm height. Similarly the electric field of frequency ranges (1, 3 & 4) radiated by TV set produced minimum electric field at 250 cm distance, 60 cm height but the electric field of frequency range 2 & 5 represents the minimum electric field at 175 cm distance, 60 cm height. The penetrated electric field of second range is lower in comparison to first range of the radiated electric field. The penetrated electric field of third range frequency is lower in comparison to first range of the radiated electric field but higher in comparison to second range of the frequency of the radiation. The penetrated electric field of forth range frequency is lower in comparison to first & third range frequency of the radiated electric field but higher in comparison to second range frequency of electric field. The penetrated electric fields of fifth range frequency is lower in comparison to first & third range frequency of the radiated electric field but higher in comparison to second & forth range of frequency of electric field. Hence the electric field due to second range frequency is smaller than all other frequencies ranges.

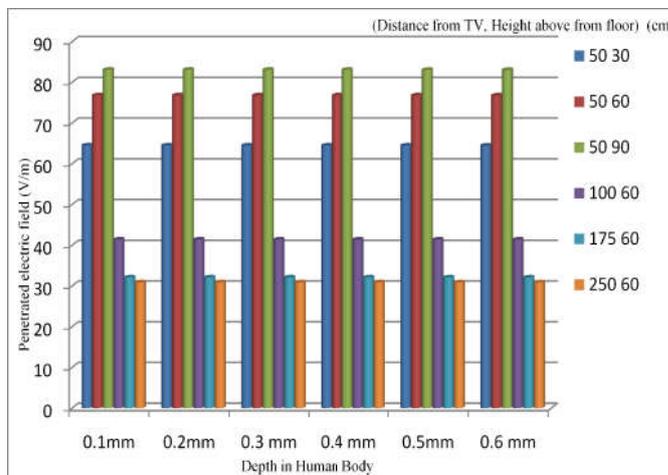


Fig 1: Penetrated electric field in blood tissues due to the radiation of CRT TV /PC screen of frequency range (10-3066) Hz
The calculated current densities in blood tissues at the

different depth of human body are represented in figure 6 to 10 for all five ranges of frequencies of the penetrated electric field radiated by CRT TV/PC screen. Similar variations are observed in current density (Figure 6 to 10) at the different depth of human body as explained above in penetrated electric field for all frequency ranges of the radiation.

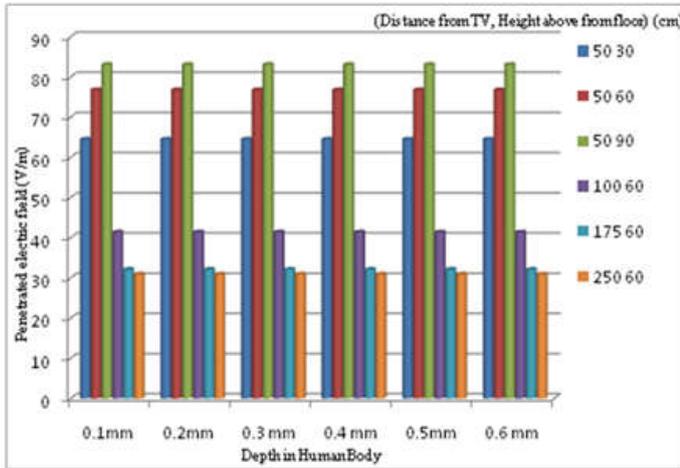


Fig 2: Penetrated electric field in blood tissues due to the radiation of CRT TV/PC screen of frequency range (10 - 54) Hz

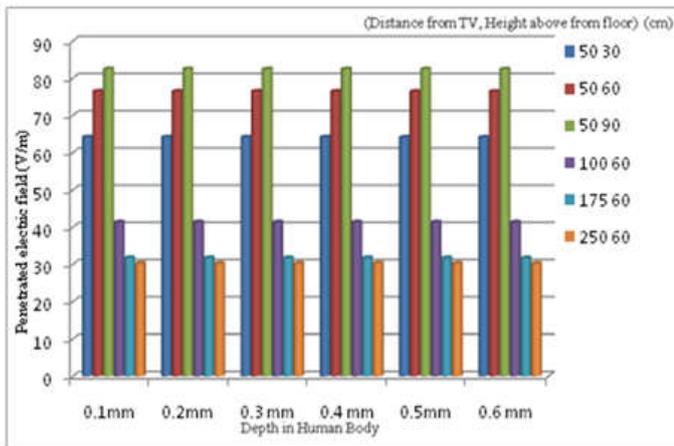


Fig 3: Penetrated electric field in blood tissues due to the radiation of CRT TV/PC screen of frequency range (54 - 606) Hz

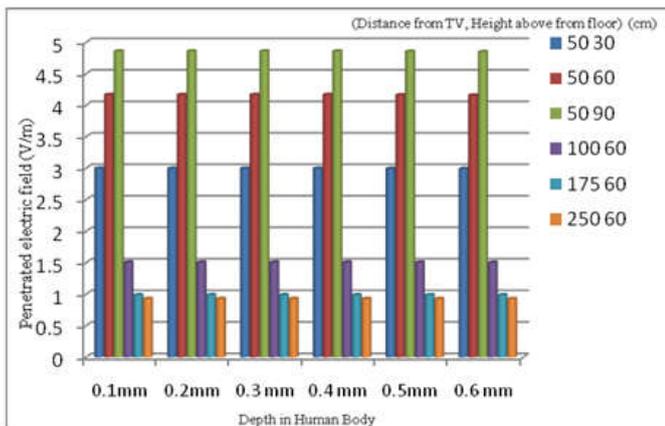


Fig 4: Penetrated electric field in blood tissues due to the radiation of CRT TV/PC screen of frequency range (606 - 3066) Hz

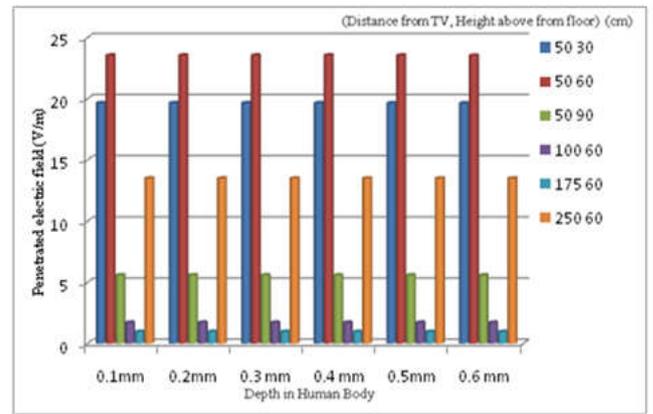


Fig 5: Penetrated electric field in blood tissues due to the radiation of CRT TV/PC screen of frequency range 120 Hz

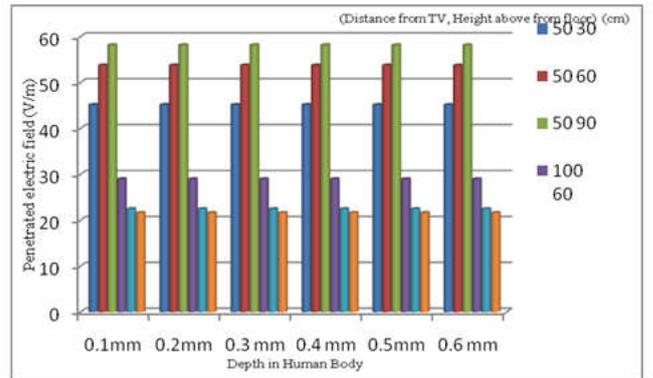


Fig 6: Current Density (A/m²) in blood tissues due to the radiation of frequency range (10-3066) Hz by CRT TV /PC screen

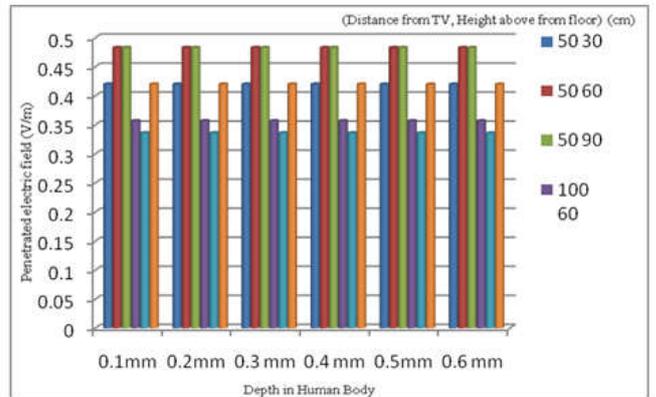


Fig 7: Current Density (A/m²) in blood tissues due to the radiation of frequency range (10 - 54) Hz by CRT TV/PC screen

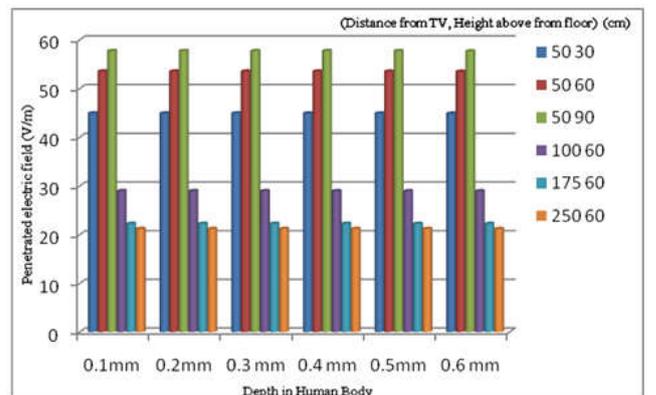


Figure 8: Current Density (A/m²) in blood tissues due to the radiation of frequency range (54 - 606) Hz by CRT TV/PC screen

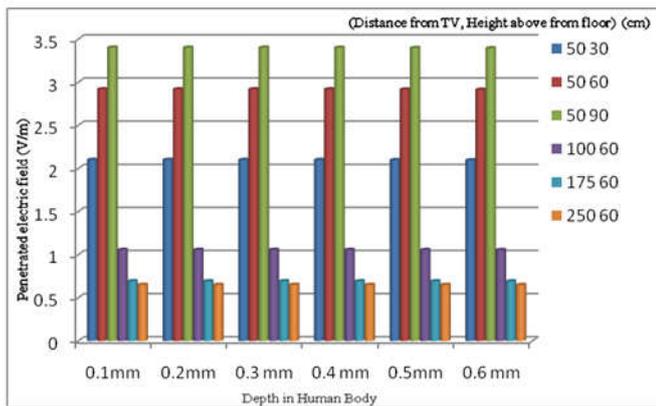


Figure 9: Current Density (A/m^2) in blood tissues due to the radiation of frequency range (606 - 3066) Hz by CRT TV/PC screen

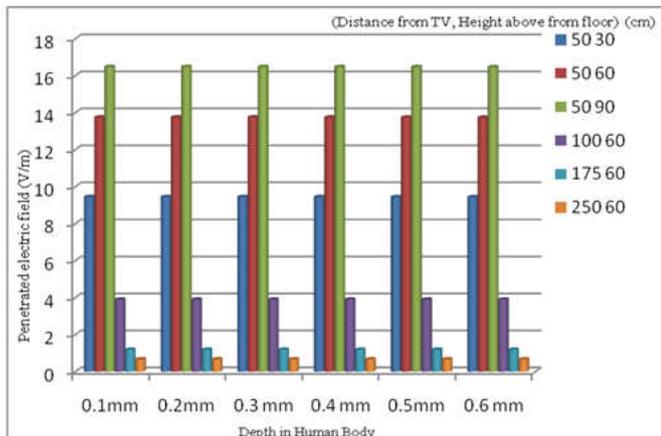


Figure 10: Current Density (A/m^2) in blood tissues due to the radiation of frequency range 120 Hz by CRT TV/PC screen

Conclusion

According to ICNIRP, the safe limit for CNS head and overall body tissues for frequency range (10 -3066) Hz are 0.01 to 0.4139 V/m and 0.4 to 0.4139 V/m respectively. The calculated electric field of figure 1 is greater to the safe limit, it means, the given penetrated electric field are harmful for the health of blood tissue. The safe range of penetrated electric field for CNS head and overall body are 0.01 to 0.0216 V/m and 0.4 v/m for (10 - 54) Hz respectively. The calculated electric field of figure 2 is greater to the safe limit. The safe limit for (54 - 606) Hz is 0.216 to 0.2424 V/m for CNS head tissue and for overall body 0.4 V/m. The calculated data of penetrated electric field are greater to this safe limit. Thus the penetrated electric fields of figure 3 are harmful for the blood tissues of CNS head and whole body. The safe limit of CNS head and overall body are 0.242 to 0.4139 V/m and 0.4 to 0.4139 V/m respectively for (606 - 3066) Hz of radiation of CRT TV. The calculated electric fields in blood of figure 4 are also greater to its safe limit. Thus this range is also harmful for the life of tissues of CNS head and overall body. Similarly safe range of CNS head and overall body are 0.48 V/m and 0.4 V/m respectively for 120 Hz radiation of CRT TV. After comparing these safe limits with the calculated electric field of table 5, it is concluded that these electric fields are also harmful for the life of blood tissue of CNS head and overall body. Figure 6 and 9 represent the current density in blood tissue due to (10 - 3066) Hz and (606 - 3066) Hz radiation of CRT TV/PC set. The safe limit of current density for blood

tissue for these frequency ranges is $0.002 A/m^2$. Thus it is concluded that these frequency ranges are harmful for the blood tissue at given distances and heights of CRT TV/ PC sets. Figure 7, 8, 9 and 10 show the calculated current density due to (10 - 54) Hz, (54 - 606) Hz, (606 - 3066) Hz and 120 Hz respectively. The safe limit for these ranges is $0.002 A/m^2$. After comparing with the safe limit, it can be concluded that the radiation of these frequencies of CRT TV/PC set are harmful for the life of blood tissue. From the above analysis, it is concluded that the CRT TV/PC screen are harmful for the blood tissue of the human beings at least the given distances and heights of the CRT TV/PC screen from earth surface. Thus people should watch TV programmes away from the above mentioned distances and heights.

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REFERENCES

- Bastide M., Youbicier-Simo B.J., Lebecq J.C. and Giaimis J. 2001. Toxicologic study of electromagnetic radiation emitted by television and video display screens and cellular telephones on chickens and mice. *Indoor Built Environ* 10: 291-298.
- Bernard L. 2008. Analysis of finite element formulations for computing electromagnetic fields in the human body. MOMAG, Florianopolis: Brazil: 1051- 1054.
- Canova A., Freschi F., Giaccone L. and Repetto M. 2010. Exposure of working population to pulsed magnetic fields. *IEEE Transactions on Magnetics* 46 (8): 2819 - 2822.
- Fact Sheet, 2010. International commission on non - ionizing radiation protection. LF: 1- 4.
- Findlay R., and Dimbylow P.J. 2010. SAR in a child voxel phantom from exposure to wireless computer networks (Wi- Fi). *Phy. Med.Biol.* 55: N405 - N411.
- Gabriel C., Gabriel S., and Corthout E. 1996. The dielectric properties of biological tissues: I Literature survey. *Physics in Medicine and Biology.* 41: 2231 - 2249.
- Gabriel S., Lau R.W., and Gabriel C. 1996. The dielectric properties of biological tissues: II Measurements in the frequency range 10 Hz to 20GHz. *Physics in Medicine and Biology.* 41: 2251 - 2269.
- Gabriel S., Lau R.W., Gabriel C. 1996. The dielectric properties of biological tissues: III Parametric models for the dielectric spectrum of tissues. *Physics in Medicine and Biology,* 41: 2271 - 2293.
- Hardell L. and Sage C. 2008. Biological effects from electromagnetic field exposure and public exposures standards. *Biomedicine and Pharmacotherapy.* XX: 1-6.
- Hoang L., Scorretti R., Burais N. and Voyer D. 2009. Numerical dosimetry of induced phenomena in the human body by a three-phase power line. *IEEE Trans. Magn* 45 (3): 1666-1669.
- ICNIRP Guidelines. 1998.Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). Preprint scheduled to appear in *Health Physics* 74 (4): 494-522.
- Johansson O. 2001. Cutaneous mast cells are altered in normal healthy volunteers sitting in front of ordinary

- tv/pcs – results from open - field provocation experiments. *Journal of Cutaneous Pathology*. 28: 513 - 519.
- Kaune W.T., Miller M.C., Linet M.S., Hatch E.E., Kleinerman R.A., Wacholder S., Mohr A.H., Tarone R.E., and Haines C. 2000. Children's exposure to magnetic fields produced by U.S. television sets used for viewing programs and playing video games. *Bioelectro magnetics*. Apr; 21(3):214-227
- Kumar V. 2010. *Effects of Electromagnetic Waves on Biological Tissues*, Lap Lambert Academic Publishing, Germany Edition Paperback 6/2010: (ISBN-10 3838320891, ISBN-13 9783838320892).
- Kumar V., Ahmad M. and Sharma A.K. 2010. Harmful effects of mobile phone waves on blood tissues of the human body. *Eastern Journal of Medicine* 15: 80-89.
- Motrescu V.C. and Rienen U. Van. 2005. Computation of currents induced by ELF electric fields in anisotropic human tissues using the Finite Integration Technique (FIT). *Advances in Radio Science* 3: 227 – 231.
- Nadejde C., Creanga D.E. and Goiceanu C. 2009. Radiofrequency electromagnetic wave and paramagnetic particle effects on the red blood cells. *Rom. Journ. Phys.* 54(1-2): 105 -114.
- Peymen A., Khalid M., Calderon C., Addison D., Mee T., Maslanyj M., and Mann S. 2011. Assessment of exposure to electromagnetic fields from wireless computer networks (Wi - Fi) in schools; results of laboratory measurements. *Health Phy.* 100 (6): 594 – 612.
