INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
10–499/AAK/2011/13–1–148–150
http://www.fspublishers.org

Short Communication

Effects of Exposure to Constant or Pulsed 50 Hz Magnetic Fields on Body Weight and Blood Glucose Concentration of BALB/C Mice

ALIREZA LOTFI[1], FARHAN AHADI†, HABIB AGHDAM SHAHRYAR‡ SAEID CHEKANI-AZAR AND POUYA FAEGHI¶
Young Researchers Club, Islamic Azad University, Shabestar Branch, 53815 Shabestar, Iran
†*Department of Animal Science, Islamic Azad University, Marageh Branch, Marageh, Iran*
‡*Department of Animal Science, Islamic Azad University, Shabestar Branch, 53815 Shabestar, Iran*
¶*Department of Electronic Science, Islamic Azad University, Tabriz Branch,Tabriz, Iran*
[1]Corresponding author's e-mail: arlotfi@gmail.com

ABSTRACT

The aim of study was to comparison of constant and pulsed ELF MF for body weight and blood glucose changes in animal model. twenty-eight female BALB/C mice were divided in to four experimental groups; group 1 or in exposure to constant 50 Hz MF for 20 day, group 2 or in exposure to 50 Hz constant MF (CMF) for 10 days, group 3 or in exposure to 50 Hz pulsed MF (PMF) for 20 day and group 4 in exposure pulsed 50 HZ MF for 10 day. Results indicated that body weight of mice hadn't significant change in exposure to 10 or 20 day exposure to CMF or PMF, but mice in group 2 with 10 day exposure to 50Hz CMF had lowest glucose level (110.2 mg/dL) in compared with other groups ($P< 0.05$). Constant 50 Hz MF is efficient for blood glucose lowering with 122.4 and 110.2 mg/dL for group 1 and 2 in compared with 138.1 and 129.2 mg/dL for groups in exposure to PMF. It is concluded that, 50 Hz CMF or PMF didn't have any effects on body weight of mice during 20 day exposing period, but 50 Hz CMF could lowered blood glucose concentration in 10 or 20 day exposure.

Key Words: Extremely low frequency; Magnetic field; Radiation; Mice

INTRODUCTION

In recent decades with extension and progress in electronic and telecommunication industries, organisms are under harmful bio-effects of electric, magnetic or electromagnetic fields, that their detrimental effects on organics specially in near of fields are accepted (Atay *et al.*, 1992). Recent epidemiologic studies have suggested that the exposure to extremely low frequency (ELF) magnetic fields (MF) affect mammalian health include liver function (Ibrahim *et al.*, 2008), cell proliferation (Çetin *et al.*, 2006), hematopoietic parameters (Amara *et al.*, 2006; Sihem *et al.*, 2006), oxidative stability (Hashish *et al.*, 2008), lipid and glucose metabolism (Bellossi *et al.*, 1996; Volkow *et al.*, 2010).

Bioelectromagnetic studies with high or low frequency electromagnetic fields have been showed increase of blood glucose level and body weight in animal models (Gerardi *et al.*, 2008; Lerchl *et al.*, 2008; Lotfi & Aghdam shahryar, 2010). Furthermore, high frequencies could induce stress in animal and change endocrine stress factor (such as cortisol), cause hyperglycemia and adiposity (Koyu *et al.*, 2005; Aghdam shahryar *et al.*, 2009; Lotfi & Aghdam shahryar, 2009). About biomagnetic effects of ELF such as 50 Hz, Sadeghi *et al.* (2006) reported blood glucose and body weight rises in exposed guinea pigs. But relative less number of studies reported different results about blood glucose or body weight with constant and pulsed MF (Amara *et al.*, 2006; Abbasi *et al.*, 2007; Öcal *et al.*, 2008). With attention to ability of high frequencies MF or EMF for glucose rising and weight gaining in animals and differences between relative results by constant or pulsed ELF MF, the aim of this study was to comparison of constant and pulsed ELF MF for ability to body weight and blood glucose changes in animal model.

MATERIALS AND METHODS

Experimental animals: In present study, 26 day-old 28 female BALB/C mice were divided in to four experimental groups; group 1 or in exposure to constant 50 Hz MF for 20 day, group 2 or in exposure to constant 50 Hz MF for 10 days (and subsequent 10 day were far of any radiation or fields), group 3 or in exposure to pulsed 50 Hz MF for 20 day and group 4 in exposure pulsed 50 HZ MF for 10 day (and subsequent 10 day were far of any radiation or fields).

To cite this paper: Lotfi, A., F. Ahadi, H.A. Shahryar and S. Chekani-Azar, 2011. Effects of exposure to constant or pulsed 50 Hz magnetic fields on body weight and blood glucose concentration of BALB/C Mice. *Int. J. Agric. Biol.*, 13: 148–150

Experimental conditions: The MFs are created with two magnetic blades (10 × 15 cm) kept with 8 cm separation with each others in plastic cages. Created gauss (500 G) was estimated by Yokogawa® 3251 G meter, Japan. Temperature of experimental animal room was 22 centigrade and animals were kept with 12 h light/dark conditions. In this experiment, plastic cages (15 × 30 cm) include magnetic bladders. In group 3 and 4, Animals were in exposure to 500G ELF MF: 50 Hz for 14 h, daily.

At 7-8 pm, all groups were weighted and fed, daily. At the end of experiment after final weighting, blood samples were collected with heart puncture method and blood glucose concentration was determined with Alcyon 300 auto analyzer (Abbott Park, IL., USA) and its commercial kits.

Statistical analyses: Obtained data were recorded in SAS software Ver. 9.1 (SAS institute, USA) and differences between groups were evaluated with independent sample t-test.

RESULTS

The body weight and blood glucose concentration of experimental groups are presented in Table I and Fig. 1.

Table I. Blood glucose and body weight of mice exposed to constant or pulsed extremely low frequency (ELF) (50Hz).

Results indicated that body weight of mice hadn't significant change in exposure to 10 or 20 day exposure to CMF or PMF, but mice in group 2 with 10 day exposure to 50Hz CMF had lowest glucose level (110.2 mg/dL) in compared with other groups ($P< 0.05$). In this experiment, constant 50 Hz MF is efficient for blood glucose lowering with 122.4 and 110.2 mg/dL for group 1 and 2, in compared with 138.1 and 129.2 mg/dL for groups in exposure to PMF (Table I).

DISCUSSION

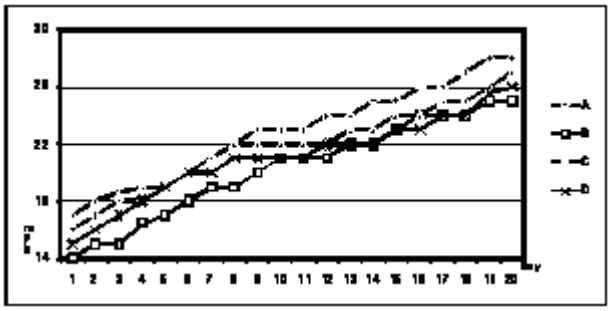
Hyperglycemia is a metabolic disorder and major cause of complications with diabetes. Also, growing evidence indicates that oxidative stress and generation of oxygen reactive species (ROS) accelerated and triggered by Hyperglycemic condition (Johansen *et al.,* 2005). Groczynska and Wegrzynowicz (1991) suggested that constant MF cause glucose homeostasis in animal with increase in insulin release, increase in glycogen and decrease in glucose level. Eraslan *et al.* (2004) indicated short-term exposure to pulsed EMF hadn't any significant effect on blood biochemical parameters in mice. But, Abbasi *et al.* (2007) reported that CMF didn't rise of glucose level and in their study for glucose levels, any difference between control and CMF exposed rats was not observed. In Öcal *et al.* (2008), healthy and diabetic rats had lower blood glucose level in exposure to CMF. In Amara *et al.* (2006) rats in exposure to static MF during 5 days had higher glucose concentration. Results of present study about glucose (Table I) were in agreement with Amara *et al.* (2005), Öcal *et al.* (2008) and Groczynska and Wegrzynowicz (1991).

Table I: Blood glucose and body weight of mice exposed to constant or pulsed extremely low frequency (ELF) (50Hz)

Experimental groups	Exposing period (day)	Exposing specify	Body weight (g)	Blood glucose concentration (mg/dL)
1	20	CMF	12.5 ± 1.51^a	122.44 ± 11.14^b
2	10	CMF	11.9 ± 2.15^a	110.21 ± 25.20^b
3	20	PMF	12.8 ± 2.55^a	138.14 ± 10.85^a
4	10	PMF	12.3 ± 3.10^a	129.25 ± 12.18^a

Different letters (a or b) indicate significant differences, $p < 0.05$

Fig. 1: Body weight gain (g) in rats exposed to constant or artificial magnetic field. A=20 days CMF, B=10 d CMF+10 d free, C=20 days PMF, D=10 d PMF+10 d free



About body weight, Öcal *et al.* (2008) reported significant increase of body weight during three week experimental period. Bellossi *et al.* (1984) reported CMF during four weeks hadn't significant effects on body weight of rats. Bellossi, in another study reported, 460 Hz PMF hadn't any effects on body weight of AKR mice (Bellossi, 1992). Our results were according to Bellossi studies for both of CMF and PMF (Bellossi *et al.*, 1984; Bellossi, 1992) (Table I; Fig. 1). Differences between present results and Öcal *et al.* (2008) may be referred to metabolic difference in diabetic condition in their study. Studies conducted with low frequency (Bahaoddini *et al.,* 2008) and high frequency EMFs (Lotfi & Aghdam shahryar, 2010) reported weight lowering effects of EMFs. Also, it was suggested, EMF_S can create environmental stress and with stimulation of cortisol secretion can increase glucose level (Koyu *et al.*, 2005; Aghdam shahryar *et al*., 2009; Lotfi & Aghdam shahryar, 2010). But it is seems that CMF by induce electric charge to cellular membrane and make dysfunctions in membranes lipid layers (Radhakrishan *et al.,* 2000) cause excessive glucose entrance to cell. Finally, it is suggested that PMF for 10 or 20 day hadn't possible biological effects on glucose level or body weight gain, but CMF in 10 or 20 day had glucose lowering effects but not

sufficient for serious metabolic change and body weight changes. Present results for glucose and body weight with CMF and PMF were opposite to relative effect of EMFs with high or low frequency, because 50 Hz CMF or PMF may be unable to create environmental stress for mice.

CONCLUSION

Fifty Hz CMF or PMF didn't have any effects on body weight of mice during 20 day exposing period, but 50 Hz CMF could lowered blood glucose concentration in 10 or 20 day exposure. PMFs hadn't any significant effects on glucose and body weight of animals.

REFERENCES

Abbasi, M., M. Nakhjavani, S. Hamidi, M. Tarafdarnia and A. Esteghamati, 2007. Constant magnetic field of 50 mT does not affect weight gain and blood glucose level in BALB/c mice. *Med. Sci. Monit*., 13: 151–154

Aghdam shahryar, H., A.R. Lotfi, M. Bahojb ghodsi and A.R. Karami bonary, 2009. Effects of 900 MHz electromagnetic fields emitted from a cellular phone on the T3, T4 and cortisol levels in Syrian hamsters. *Bull. Vet. Inst. Pulawy*, 53: 233–236

Amara, S., H. Abdelmelek, M. Ben Salem, A. Rached and M. Sakly, 2006. Effects of Static Magnetic Field Exposure on Hematological and Biochemical Parameters in Rats. *Brazilian Arch. Biol. Technol*., 6: 889–895

Atay, Z. and T. Topalidis, 1992. *Cytodiagnostik der Serösen Höhlen Atlas und Lehrbuch Wolfgang Pabst Verlag*, pp: 18–19 & 100–101. Herausgeber, A and T Hannover, Germany

Bahaoddini, A., H. Mohabatkar, N. Afrooz and S. Keshtgar, 2008. Effect of exposure to low frequency electromagnetic field on the plasma glucose, insulin, triglyceride and cholesterol of male rats. *J. Appl. Anim. Res.*, 34: 016

Bellossi, A., 1992. Effect of a 12 Hz and of a 460 Hz Pulsed magnetic field on the weight of AKR mice. *Biotherapy*, 4: 277–283

Bellossi, A., M.T. Sutter-Dub and B.C. Sutter, 1984. Effects of constant magnetic fields on rats and mice: a study of weight. *Aviat. Space Environ. Med*., 55: 725–730

Bellossi, A., V. Pouvreau-Quillien, C. Rocher and M. Ruelloux, 1996. Effect of pulsed magnetic fields on cholesterol and frequency de levels in rats study of field intensity and length of exposure. *Z. Naturforsch [C]*, 51: 603–606

Çetin, N., A. Bilgili and G. Eraslan, 2006. Effects of pulsed magnetic field chronic exposure on some hematological parameters in mice. *Revue. Méd. Vét*., 2: 68–71

Eraslan, G., M. Akdogan, E. Yarsan, D. Essiz, F. Sahindokuyucu and L. Altintas, 2004. Effects of short-term exposure to pulsed electromagnetic field on some biochemical parameters in mice. *Indian J. Biochem. Biophys.*, 41: 57–59

Gerardi, G., A. De Ninno, M. Prosdocimi, V. Ferrari, F. Barbaro, S. Mazzariol, D. Bernardini and G. Talpo, 2008. Effects of electromagnetic fields of low frequency and low intensity on rat metabolism. *Biomagn. Res. Technol.*, 6: 3

Groczynska, E. and R. Wegrzynowicz, 1991. Glucose homeostasis in rats exposed to magnetic field. *Invest. Radiol.*, 26: 1095–1100

Hashish, A.H., M.A. El-Missiry, H.I. Abdelkader and R.H. Abou-Saleh, 2008. Assessment of biological changes of continuous whole body exposure to static magnetic field and extremely low frequency electromagnetic fields in mice. *Ecotoxicol. Environ. Saf.*, 3: 895–902

Ibrahim, M., M. El-ashry and E. Ali, 2008. The influence of 50 Hz magnetic field on liver function. *Romaninan J. Biophys*., 18: 113–122

Johansen, J.S., A.K. Harris, D.J. Rychly and A. Ergul, 2005. Review: Oxidative stress and the use of antioxidants in diabetes: Linking basic science to clinical practice. *Cardiovas. Diabetol*., 4: 5–5

Koyu, A., G. Cesur, F. Özgüner and O. Elmas, 2005. Cep telefonlarindan yayilan 900 MHz elektromanyetik alanin serum kortizol ve testosterone hormonu uzerine etkisi. *S.D.U. Tip. Fak. Derg.*, 12: 52–56

Lerchl, A., H. Krüger, M. Niehaus, J.R. Streckert, A.K. Bitz and V. Hansen, 2008. Effects of Mobile phone electromagnetic fields at non thermal SAR values on melatonin and body weight of Djungarian hamsters (phodopus sungorus). *J. Pineal Res.*, 44: 267–272

Lotfi, A.R. and H. Aghdam Shahryar, 2009. Effects of 900 MHz electromagnetic fields emitted by cellular phone on total cholesterol and triglyceride levels of plasma in Syrian hamsters (*mesocricetus auratus*). *J. Appl. Biol. Sci*., 3: 85–88

Lotfi, A.R. and H. Aghdam Shahryar, 2010. Changes in body weight and blood glucose level of female Hamster (*Mesocricetus auratus*) in exposure to 900 MHz electromagnetic fields emitted by cellular phone. *In: Proc. of 12th Rodens et Spatium, International conference on Rodent Biology, Zonguldak-Turkey*, p: 95. 19-23 July 2010

Öcal, I., T. Kalkan and I. Günay, 2008. Effects of alternating magnetic Field on the metabolism of the healthy and diabetic organisms. *Brazilian Arch. Biol. Technol*., 51: 523–530

Radhakrishan, A. and H.M. McConnell, 2000. Electric field effect on cholesterol-phospholipid complexes. *PNAS*, 97: 1073–1078

Sadeghi, H., S. Zare, H. Hayatgeibi, S. Alivandi and A.G. Ebadi, 2006. Biological effect of power frequency magnetic fields on serum biochemical parameters in guinea pigs. *Pakistan J. Biol. Sci.*, 6: 1083–1087

Sihem, C., A. Hafedh, S. Mohsen, P.J. Marc and B. Khmais, 2006. Effects of sub-acute exposure to magnetic field on blood hematological and biochemical parameters in female rats. *Turkish J. Hematol*., 23: 182–187

Volkow, N.D., D. Tomasi, G.J. Wang, J.S. Fowler, F. Telang, R. Wang, D. Alexoff, J. Logan, C. Wong, K. Pradhan, E.C. Caparelli, Y. Ma and M. Jayne, 2010. Effects of low-field magnetic stimulation on brain glucose metabolism. *Neuroimage*, 51: 623–628

(Received 05 October 2010; Accepted 28 October 2010)