J. BIOL. ENVIRON. SCI.,
2012, 6(16), 49-53

Effects of Exposure to 50 Hz Electromagnetic Fields during Incubation on Some of Serum Biochemical Measures in Newly-Hatched Chicks

Alireza Lotfi[1*], Habib Aghdam Shahryar[2] and Mohammad Narimani-Rad[1]
[1] Ilkhchi Branch, Islamic Azad University, Ilkhchi, IRAN
[2] Department of Animal Science, Shabestar Branch, Islamic Azad University, Shabestar, IRAN

ABSTRACT

The aim of present study was to determine the effect of intermitted exposure to 50 Hz, 0.5 mT electromagnetic fields (EMF) during different periods of incubation on serum biochemical parameters (glucose, total cholesterol, triglyceride, uric acid and iron concentration) in newly-hatched chicks. Experimental groups were: group 1 (control), with normal incubation process and without any exposing to EMF; group 2 included eggs exposed to 50Hz, 0.5 mT EMF, 2 h daily for 0-7 day of incubation; group 3 included eggs exposed for 2 h daily from day-8 to -14 of incubation; group 4; included eggs exposed from day-15 to -21 of incubation, and group 5 included eggs exposed from day-1 to -21 of incubation (whole incubation period). Incubation condition with exception to EMF exposing, was similar for all groups. At EMF exposure time, eggs were transferred to EMF emitter set and after exposure time, eggs were transferred to their rows (setter). Blood samples obtained from newly hatched chicks were analyzed. exposure to EMF: 50 Hz, 0.5 mT during embryonic life didn't has considerable effect on total cholesterol, triglyceride, uric acid and Fe of newly hatched chicks. In present study, the only measure with significant changes was glucose concentration that had difference between group4 or 5 (exposed at 3rd or whole incubation period) and control group (P<0.05). It was concluded that exposure to EMF: 50 Hz, 0.5 mT during incubation with exception to glucose declining at late embryonic life (exposure at 3rd week), didn't has any significant effect on plasma total cholesterol, triglyceride, iron or uric acid in hatched chicks.

Key Words: Electromagnetic fields, exposure, incubation, serum biochemical parameters, chicken embryo.

INTRODUCTION

Nowadays, electromagnetic field (EMF) and its hazardous or beneficial biological effects is subject of so many studies on human and animals. Exposure to EMF was studied in poultry at pre-incubation (Shams Lahijani and Sajadi 2004), during-incubation (Ingole and Ghosh 2006; Batellier *et al*. 2008) or post-incubation (Cuppen et al. 2007).

The environmental factors that are most critical to the optimal development of the embryo are those thatoccur during the incubation and hatching processes. Any alterations in incubation environment influences themetabolism and growth of embryos with possible consequent at post-hatch life and affect finishing outcome especially in broiler type chicken via changes in the efficiency of nutrient metabolism and utilization (Shafey, 2006, Shafey *et al.,* 2007). At current decade, researchers have done focused on other environmental factors in hatching process such as light color (Shafey, 2006), electric fields (Shafey *et al*., 2007) and electromagnetic fields (EMF) (Ingole and Ghosh, 2006; Batellier *et al.,* 2008). During rearing period, regardless to hazardous effects of fields, EMFs could apply as anti-coccidiosis agent (Elmusharaf *et al*., 2007).

During incubation, embryonic exposure to EMFs had detrimental effects on embryo development and hatching results (Pisiriciler *et al*., 2000; Batellier *et al*., 2008). Along with negative effect of EMFs on development, various studies had reported effects of EMFs (50-60 Hz) on blood biochemical parameters in mammalian models (Cetin *et al.* 2006; Anselmo *et al.* 2009; Lotfi *et al.* 2011). It was reported pulse 60Hz and 3 microtesla EMF caused hyperglycemia in pregnant rats (Anselmo *et al.* 2009), but exposing to continuous 50Hz EMF caused hypoglycemia in mouse (Lotfi *et al.* 2011). About plasma lipids, the lowering effects of extremely low frequency EMF or MF has been reported in some of past relative studies (Ocal *et al*. 2008), but Torres-Duran *et al.* (2008) and Sihim *et al.* (2006) didn't have any change for plasma lipid concentration of exposed animals in their experimental works. Because of these differences between results, aim of this study was to investigation on intermitted exposure to 50 Hz, 0.5 mT electromagnetic fields during different periods of incubation on biochemical measures of blood in newly-hatched chicks, whereas this frequency of EMF was studied on hatching results in past reports.

* Corresponding author: arlotfi@gmail.com

MATERIALS AND METHODS

Design and description of EMF emitter set

The EMF producer was designed for produce EMF with 50Hz frequency and 0.5 mT intensity with using urban electric line. An adaptor 220 v to 110 v (10 A) was used for minimizing of heat production by EMF emitter coin (Fig. 1). The EMF emitter set including bobbin (80 × 10 cm), wires and metal nucleuses was put in the bottom of hatchery machine in a metal lacuna (Fig. 1).

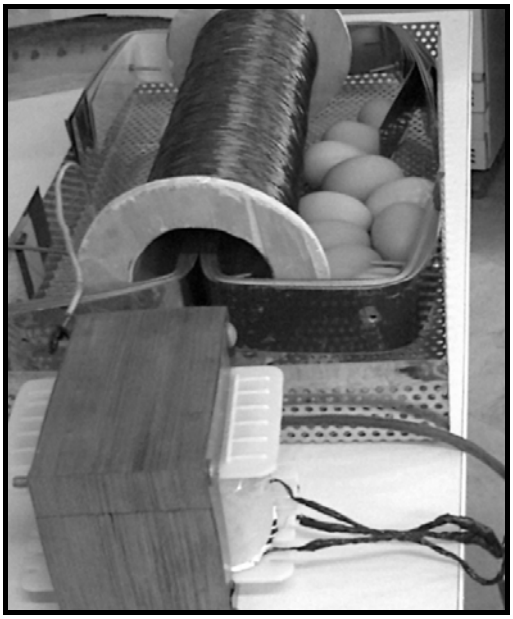

Figure 1. Image of EMF emitter set and exposed eggs used in present experiment that installed in bottom of incubator as EMF exposing site.

Experimental groups, incubation and EMF exposing

450 fertilized eggs with similar weight were collected from commercial broiler breeder (Ross 308) farm. Experimental design was completely randomized design (CRD) with five treatment, three replicate for each one and 50 eggs for each replicate. Experimental groups were included 1) control; had normal incubation process and without any exposing to EMF, group 2) includes eggs exposed to 50Hz, 0.5 mT, 2h daily for 0-7 day of incubation, group 3) includes eggs exposed to 50Hz, 0.5 mT, 2h daily from day-8 to day-14 of incubation, group 4) includes eggs exposed to 50Hz, 0.5 mT, 2h daily from day-15 to day-21 of incubation and group 5) includes eggs exposed to 50Hz, 0.5 mT, 2h daily from day-1 to day-21 of incubation (whole incubation period).

Hatchery temperature and humidity were regulated as 37.8°c, 55% RH from day-1 to day-18, and 37.2°c, 70% RH from day-18 to day-21 (hatching). At EMF exposing time, EMF set were separated from setters (eggs in upper rows) via aluminum sheet coverage for avoiding any unfavorable exposure of other experimental groups. Also bottom of unexposed groups were covered with another aluminum sheet. At EMF exposing time (2h daily) eggs were transferred to EMF emitter set (lacuna) and after exposing period, eggs were transferred to their rows (setter). Egg transfers were done in 15 min for avoiding possible detrimental temperature change of incubation (Fig. 2).

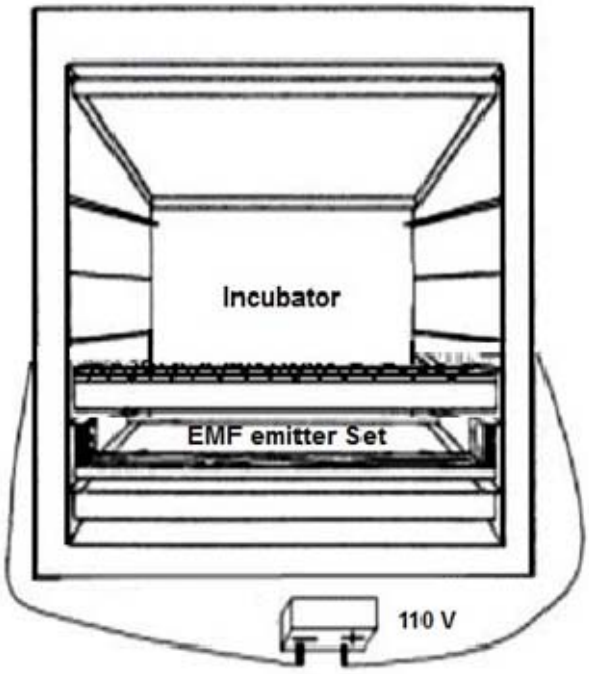

Figure 2. Schema of incubator and EMF exposing condition.

Laboratory assays

After hatching, chicks of all groups were weighted and six chicks from each experimental group were slaughtered and blood samples were collected in acid washed tubes. Next, serum was separated via centrifuge and transferred to hematology laboratory for assay of glucose, total cholesterol, uric acid and iron (Fe) concentrations by Alyson (300, USA) auto-analyzer.

Statistical analysis

Collected data were analyzed by SAS software Ver. 9.1 and Duncan multiple Tests were applied to find significant differences among means of groups.

RESULTS

According to table1, exposure to EMF: 50 Hz, 0.5 mT during embryonic life didn't has considerable effect on total cholesterol, triglyceride, uric acid and Fe of newly hatched chicks. In present study, the only measure with significant changes was glucose concentration that had difference between group4 or 5 (exposed at 3rd or whole incubation period) and control group ($P<0.05$).

Table 1. Some of serum biochemical measures in hatched chicks submitted to intermitted electromagnetic fields during incubation.

Groups	EMF duration	Glucose (mg/dl)	Total cholesterol (mg/dl)	Triglyceride (mg/dl)	Uric acid (mg/dl)	Iron (Fe) (mg/dl)
1	unexposed	213.7[a]	359.3	66.7	4.7	109.0
2	50Hz, 0.5 mT 0-7d, 2h daily	212.7[a]	473.0	95.0	6.0	128.3
3	50Hz, 0.5 mT 8-14d , 2h daily	209.07[ab]	342.0	71.6	5.4	87.0
4	50Hz, 0.5 mT 15-21d , 2h daily	184.0[b]	312.0	63.3	4.9	93.6
5	50Hz, 0.5 mT 0-21d , 2h daily	183.0[b]	350.0	80.0	4.2	92
P value	-	0.0471	0.0995	0.7192	0.3220	0.3233
SEM	-	8.324	29.632	12.423	0.673	13.227

Different letters (a or b) shows significant difference between experimental groups.

DISCUSSION

Exposure to high frequency or high intensity of MF or EMF (Amara *et al.* 2006; Lotfi and Aghdam Shahryar, 2010) because of stress induction and cortisol-releasing ability may cause increase blood glucose concentration, but intermitted exposure to low frequencies has different effect and cause blood glucose decline (Abbasi *et al,* 2007: Pazireh *et al.* 2008; Lotfi *et al*. 2011). In this subject, Sieroń *et al*. (2007) had a hypothesis that direct exposure to low frequency EMFs can change glycemic status with facilities glucose abortion by tissues and membranes permeability for peripheral glucose and in other side, insulin activity for insulin-dependent tissues. Present findings (table1) for glucose lowering effect of EMF at late embryonic life of chicks is according to Abbasi *et al.* (2007), Pazireh *et al.* (2008), and Lotfi *et al.* (2011) reports and also Sieroń *et al.* (2007) hypothesis. Lahbib *et al.* (2010) had shown the effects of low frequency MF on glucose and lipid metabolism are time-dependent and short-term exposure (five days) couldn't affect plasma lipids, significantly. Whereas, fifteen days exposing period had significant effect on glucose and lipid metabolism in animal models. Zecca *et al*. (1998) in their study with 50 Hz and 5 microtesla EMF couldn't record any considerable changes for total cholesterol during 8 months experimental period. In present study in agreement to Zecca *et al.* (1998) report in rat model, exposure to EMF: 50 Hz, 0.5 mT during embryonic life didn't has significant effect on plasma lipids at any of exposure time; first, second or third weeks of embryonic model.

It was concluded that exposure to EMF: 50 Hz, 0.5 mT during incubation with exception to glucose declining at late embryonic life (exposure at 3rd week), didn't has any significant effect on plasma total cholesterol, triglyceride, iron or uric acid in hatched chicks.

ACKNOWLEDGMENT

This manuscript is summarized from research project No. 88536. The financial supports for this project were provided by Young Researchers Club, Islamic Azad University, Iran.

REFERENCES

Abbasi M, Nakhjavani M, Hamidi S, Tarafdarnia M, Esteghamati A (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.

Anselmo CWSF, Pereira PB, Catanho MTJA, Medeiros MC (2009). Effects of the Electromagnetic field, 60 Hz, 3 μT, on the hormonal and metabolic regulation of undernourished pregnant rats. Brazilian J Biol 69(2): 397-404.

Batellier F, Couty I, Picard D, Brillard JP (2008). Effects of exposing chicken eggs to a cell phone in ''call''position over the entire incubation period. Theriogenology 69: 737–745.

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

Cuppen JJM, Wiegertjes GF, Lobee HWJ, Savelkoul HFJ, Elmusharaf MA, Beynen AC, Grooten HNA, Smink W (2007). Immune stimulation in fish and chicken through weak low frequency electromagnetic fields. Environmentalist 27: 577- 583.

Elmusharaf MA, Cuppen JJ, Grooten HNA, Beynen AC (2007). Antagonistic effect of electromagnetic field exposure on coccidiosis infection in broiler chickens. Poult Sci 86: 2139–2143.

Ingole IV, Ghosh SK (2006). Exposure to radio frequency radiation emitted by cell phone and mortality in chick embryos (Gallus domesticus). Biomed Res 17 (3): 205-210.

Lahbib A, Elferchichi M, Ghodbane S, Belguith H, Chater S, Sakly M, and Abdelmelek H (2010). Time-dependent effects of exposure to static magnetic field on glucose and lipid metabolism in rat. Gen Physiol Biophys 29(4): 390-395.

Lotfi A, Ahadi F, Shahryar HA, Chekani-Azar S, and Faeghi P (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.

Lotfi A and Aghdam Shahryar H (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 proceeding of 12th Rodens et Spatium, International conference on Rodent Biology. Zonguldak, Turkey, 19-23 July 2010. P, 95

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

Pazireh N, Yaghmaei P, Parivar K, Deranian D (2008). Effects of 50 Hz electromagnetic fields on LDH enzyme and blood glucose level of exposed mouse. Quarterly of Animal Biology (Islamic Azad University- Damghan Branch), 1(1): 15-20.

Pisiriciler R, Körpınar M, Toprak A, Kalkan N, Tunaya M (2000). Dusuk frekansli elektromanytik alanin tavuk embriyo hucrelerine etkisi. Istanbul Univ Vet Fak Derg 4: 1-7.

Shafey TM (2006). Effect of lighted incubation on embryonic growth and hatchability performance of two strains of layer breeder eggs. British Poult Sci 45: 223-229.

Shafey TM, Shalaby MI, and Bayoumi MS (2007). Effects of Electric Field during Incubation of Eggs on the Hatchability and Post-Hatch Performance of Meat Chickens. Int J Poult Sci 6: 1-7.

Shams Lahijani M, and Sajadi K (2004). Development of preincubated chicken eggs following exposure to 50 Hz electromagnetic fields with 1.33-7.32 mT flux densities. Indian J Experim Biol 42: 866-870.

Sieroń A, Brus H, Konecki J, Cieślar G, Szkilnik R, Nowak P, Noras Ł, Kwieciński , Kostrzewa RM, and Brus R (2007). Effect of Low Frequency Electromagnetic Fields on. [3H]Glucose Uptake in Rat Tissues. Polish J Environ Stud 16: 309- 312.

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

Torres-Duran PV, Ferreira-Hermosillo A, Juarez-Oropeza MA, Elias-Viñas D, and Verdugo-Diaz L. 2007. Effects of whole body exposure to extremely low frequency electromagnetic fields (ELF-EMF) on serum and liver lipid levels, in the rat. Lipids Health Dis 16: 31-37.

Zecca L, Mantegazza C, MargonatoV, Cerretelli P, Caniatti M, Piva F, Dondi D, Hagino N (1998). Biological effects of prolonged exposure to ELF electromagnetic fields in rats: III. 50 Hz electromagnetic fields. Bioelectromagnetics 19(1): 57-66.