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Full Length Article

Effects of Exposure to 50 Hz, 0.5 mT Electromagnetic Fields during Incubation on Whole Body and Internal Organs Weight in Broiler Chicks

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ABSTRACT

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 internal organ (liver, heart, spleen, intestine & gizzard-preventriculus) weights 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 50 Hz, 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). Exposure to EMF could not have any considerable effect on hatching weight, heart, spleen and gizzard-preventriculus weights of hatched chicks. Liver and intestine weight was affected by exposure to EMFs at third week of incubation (days 15-21), negatively ($p<0.01$). The intestine weight only in group 2 was more than control group ($p<0.01$). It was concluded that embryonic exposure to EMF: 50 Hz, 0.5 mT at 0-7 day or 8-15 day of incubation had no negative effect on whole body weight, liver, heart, spleen, intestine and gizzard- preventriculus weights, but EMF exposing at 15-21 d of incubation may have negative effect on liver and intestine weights with lowers organ size. Whole period (day 0-21) exposure to EMF: 50 Hz, 0.5 mT did not change organ weights. It is suggested that embryo could adapt for EMF exposure during incubation period, without any decrease in organ weights. © 2011 Friends Science Publishers

Key Words: Electromagnetic fields; Exposure; Incubation; Organ weight; 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 & Sajadi, 2004), during-incubation (Ingole & Ghosh, 2006; Batellier *et al*., 2008) or post-incubation (Cuppen *et al.,* 2007).

It has been well documented that when conditions were optimal, chick embryos developed normally and hatched in approximately 21 d (Yalcin & Siegel, 2003), but hatchery factors includes turning,vital gas exchange, temperature, humidity and other environmental factors (Lundy, 1969) have been shown to affect embryo growth. 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 & 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 significant (Boorman *et al*., 1997) or not significant (Erpek *et al*., 2007) effects of EMFs (50-60 Hz) on organ weight in mammalian models. Because of this

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difference between results (Boorman *et al*., 1997; Erpek *et al*., 2007) and effects of 50 Hz EMF on development (Pisiriciler *et al*., 2000). Aim of this study was to investigation on intermitted exposure to 50 Hz, 0.5 mT electromagnetic fields during different periods of incubation on hatching weight and Internal organ (liver, heart, spleen, intestine & gizzard- preventriculus) weights in newly-hatched chicks.

MATERIALS AND METHODS

Study laboratory: This experiment was conducted on Spring-2011 at laboratory complex of Islamic Azad University- Shabestar branch, Iran.

Design and description of EMF emitter set: The EMF producer was designed for produce EMF with 50 Hz 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).

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 50 Hz, 0.5 mT, 2 h daily for 0-7 day of incubation, group (3) includes eggs exposed to 50 Hz, 0.5 mT, 2 h daily from day-8 to day-14 of incubation, group (4) includes eggs exposed to 50 Hz, 0.5 mT, 2 h daily from day-15 to day-21 of incubation and group (5) includes eggs exposed to 50 Hz, 0.5 mT, 2 h 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 (2 h 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).

Weighting of internal organs: After hatching, chicks of all groups were weighted and six chicks from each experimental group were slaughtered and internal organs include liver, heart, spleen, intestine and gizzard-preventriculus were dried and weighted. Weights of organs were recorded as g/100 g BW.

Statistical analysis: Collected data were analyzed by SAS software Ver. 9.1 and Tukey's Studentized Range (HSD) Test were applied to find significant differences among groups.

RESULTS AND DISCUSSION

Hatching weight of control and all of hatched chicks was presented as Fig. 3. All of exposed groups (2, 3, 4 or 5) in comparison with control (group 1) didn't have any significant difference statistically, regardless to slight decreases for group2.

With attention to Table I, exposure to EMF couldn't have any considerable effect on heart, spleen and gizzard+preventriculus weights of hatched chicks. But liver and intestine weight had affected by exposure to EMFs at third week of incubation (days 15-21), negatively ($p<0.01$). The intestine weight only in group 2 (EMF exposed during first week of incubation) was more than control groups ($p<0.01$).

In laboratory animals Boorman *et al.* (1997) and Lotfi *et al.* (2011) with constant or pulsed 50-60 Hz MF and EMFs didn't observe any significant changes in body weight before and after experimental period. In hatchery experiment, Shafey *et al.* (2007) had reported that exposure to 30 kV/m, 60 Hz electric fields during incubation caused hatching weight increases. Veicsteinas *et al.* (1996) had concluded that intermitted exposure to 50 Hz MF during incubation couldn't affect hatching weight considerably. Present findings about hatching weight (in exposure to 50 Hz EMF) are according to past report with MF: 50 Hz (Veicsteinas *et al.,* 1996), but apposite to this Shafey *et al.* (2007) reports with electric fields, in present experiment did not observe any considerable weight increases for any exposed groups, although minor weigh increase was occurred for group exposed at last week of incubation (embryonic day 15-21).

As regards internal organs, in mammalian model, Erpek *et al*. (2007) had reported that liver weight didn't have significant change in exposure to 50 Hz, 6 mT for two months, 2 h daily. In hatchery experiments, Shafey *et al.* (2007) reported lower proportions of liver plus heart plus gizzard in chicks exposed to electric fields when compared with those of the control birds. He had suggested, exposing to 60 Hz electric fields had negative effect on organ weight. Jové *et al*. (1999) that had study on development of chick pineal gland in exposure to EMF, reported significant lower developmental parameters for 15-days-old embryonic pineal gland in exposure to EMF. On the other hand, Zhang *et al.* (1993) could not find any adverse effect of exposure to 60 Hz EMF in oxygen consumption and chick embryonic grow. in present study we couldn't find considerable changes in organ weight for groups exposed at first or second week of incubation, also there was no changes in organ weights between control group and whole period (0-21 d) exposed groups. But only in groups 4 that exposed to

Table I: Liver, heart, intestine, spleen and gizzard-preventriculus weights (g/100 g BW) in hatched chicks submitted to intermitted electromagnetic fields during incubation

Groups	EMF duration	Liver	Heart	Intestine	Spleen	Gizzard + Preventriculus
1	unexposed	2.399 [a]	0.853	4.880 [b]	0.042	5.180
2	50Hz, 0.5 mT 0-7d, 2h daily	2.433 [a]	0.856	5.214 [a]	0.043	5.406
3	50Hz, 0.5 mT 8-14d , 2h daily	2.497 [a]	0.840	5.133 [ab]	0.052	5.251
4	50Hz, 0.5 mT 15-21d , 2h daily	2.260 [b]	0.825	4.066 [c]	0.050	4.916
5	50Hz, 0.5 mT 0-21d , 2h daily	2.474 [a]	0.839	4.970 [ab]	0.052	5.066
P value	-	0.0004	0.8393	<.0001	0.3893	0.2125
SEM	-	1.0178	0.0211	0.0648	0.0048	0.1395

-different letters (a, b or c) shows significant difference between experimental groups

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

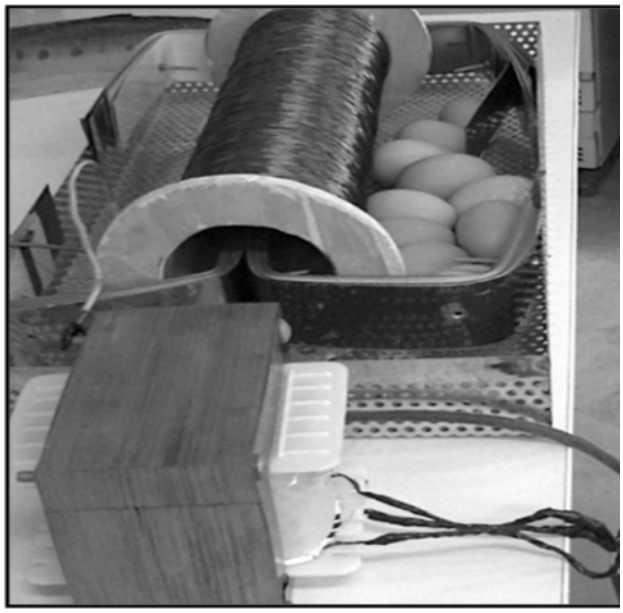


Fig. 2: Schema of incubator and EMF exposing condition

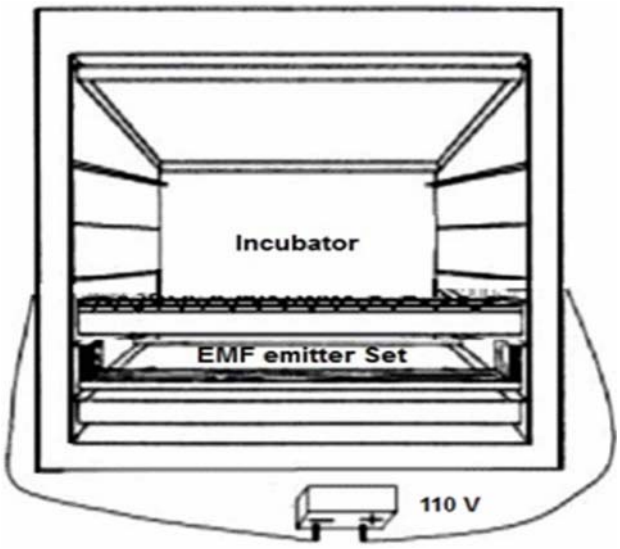
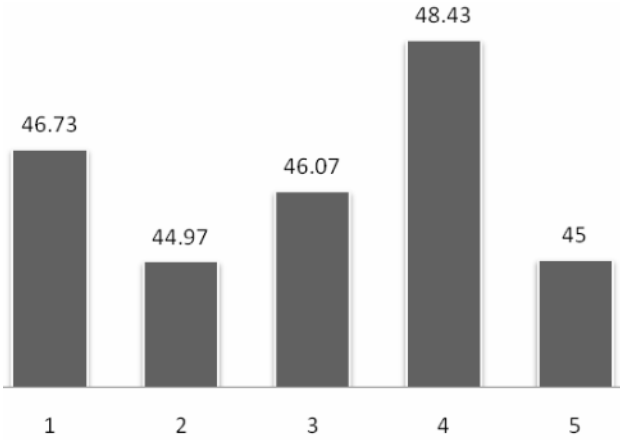


Fig. 3: Body weight (g) of hatched chicks submitted to intermitted electromagnetic fields during incubation



EMF during 3rd week of incubation (15-21 d), liver and intestine weight had decreases significantly in comparison with other groups.

It seems that late stage exposure to EMF caused slow proliferation and morphogenesis in liver. The Hepatocyte precursors were first generated all over the primordia surrounding the vitelline blood vessel at embryonic day 2 (Suksaweang *et al.*, 2003) and in late embryonic period liver become enlarged and considerable functional or morphological development of chick liver such as formation of subendothelial space were occurred at late incubation specially after day-16 (Sandström & Westman, 1971; Suksaweang *et al*., 2003). Our observation for liver weight in group 4 is in agreement with Sandström and Westman (1971) and Suksaweang *et al*. (2003). In Leksrisompong *et al*. (2007) study with temperature elevation at last week of incubation, hatching liver weight changed significantly. It is suggested that liver size at 3rd week of incubation is more sensitive to environmental conditions. Old literature (Hamburger & Hamilton, 1951) suggests that intestine development occurs during 2–10 embryonic days, but Southwell (2006) described stages of intestinal development up to stage 36. Functional morphogenesis of large intestine occurs after embryonic day-12 (Bellairs & Osmond, 2005). In present study decreases in intestine weight that occurred in exposed group at last week of incubation may be because of adverse effects of EMF on intestine morphogenesis and

formation in this stage, in agreement with Bellairs and Osmond, (2005). Interestingly, in present study whole time exposed (day 0-21) group (group 5) had no significant decreases in all of measured organ weights (Table I). Veicsteinas *et al.* (1996) reported that magnetic field at 50 Hz does not cause developmental anomalies or malformations in the brain, liver or heart. Based on present findings and those of Veicsteinas *et al*. (1996), it is suggested that exposure to EMF: 50 Hz during whole incubation period couldn't have adverse effect on organ weights and it may be because of possible adaptation of embryo to EMF, but exposure to EMF only in last week of incubation can had detrimental effect on liver and intestine weight.

CONCLUSION

Embryonic exposure to EMF: 50 Hz, 0.5 mT at 0-7 day or 8-15 day of incubation had no negative effect on hatching weight, liver, heart, spleen, intestine and gizzard-preventriculus weights, but EMF exposing at 3rd week of incubation (day 16-21) may have negative effect on liver and intestine weights with lowers organ size. Also whole period (day 0-21) exposure to EMF: 50Hz, 0.5 mT didn't change organ weights. It seems that embryo could adapt for EMF exposing during incubation period, without any decrease in whole body weight, organ weights. Further *in vivo* and *in vitro* embryological and developmental studies are needed to identification of possible reasons of these differences of exposure to EMFs in different periods.

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