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## Effects of Electromagnetic Fields of Cellular Phone on Cortisol and Testosterone Hormones Rate in Syrian Hamsters (*Mesocricetus auratus*)

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**Abstract:** In this study, the effects of exposure to a 950 MHz electromagnetic field (EMF) emitted from cellular phones on serum testosterone and cortisol hormones rate of adult male Syrian Hamster were evaluated. Seventy two male Hamster in 3 groups include: group 1 or control group, group 2 or expose for 10 days and under 950 MHz EMF (emitted from Cellular Phone) for 1 h daily group 3 or expose for 50 days and under 950 MHz EMF for 1 h daily. In final, blood samples collected for determine of the testosterone and cortisol concentration in the serum. Results showed that in long term exposure EMF (group 3) testosterone and cortisol levels were increased ( $p < 0.01$ ), but both of cortisol and testosterone hormones in short term EMF exposure (group 2) did not significantly change. In conclusion, long-term exposure of cellular phones EMF may affect the reproductive activity and impair endocrine homeostasis and it may cause peripheral effects.

**Key words:** EMF, exposure, endocrine, blood sample

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### INTRODUCTION

Nowadays, with growth in mobile communications, exposure to non-ionizing electromagnetic field (EMF) has increased due to mobile handset and base station antenna. Electromagnetic fields penetrate the animal body and act on all organs, altering the cell membrane potential and the distribution of ions and dipoles. These alterations may influence biochemical processes in the cell (Lee *et al.*, 2004).

It's shown that Microwaves (as specially waves from electromagnetic fields of cellular phones) cause to produce temperature and energy distribution in live tissues (Hirata *et al.*, 2002; Lerchl *et al.*, 2008). Temperature is an important factor in regulation of endocrine hormones releasing (Squires, 2003).

Also, these waves with extremely low frequency (in long term) make to get some variations in structure and Biochemical properties of the tissues (Lee *et al.*, 2004). In related to electromagnetic radiations (EMR) and EMF and their effects on nervous and endocrine systems, it has been done a lot of experiments well (Lai, 1992; Koyu *et al.*, 2005a, b).

It's reported that magnetic fields (MFs) cause to hormonal increasing such as glucagons, cortisol and thyroxin in the rats (Gorczyńska and Wegrznowics, 1991).

One of the other hormones of endocrine is related to cortisol. Cortisol excreted from Adrenal gland and is a stress indicator (Squires, 2003). Base on human's studies; it's approved increasing of serum cortisol as a result of EMF exposure (Radon *et al.*, 2001).

According to Vangelova *et al.* (2007) studies, it's recognized that cortisol hormone of physiotherapists has a significant difference in long term electromagnetic fields exposure as well as the

cortisol of the nurses. They stated, physiotherapists have a high rate in stress hormones because of any long term exposure of EMFs.

Studies have been shown that MFs and 1 EMFs may change hormonal balance of sex hormones and affect reproductive activity (Cakir *et al.*, 2003; Al-Akhras *et al.*, 2005).

Also, exposure of EMFs in rats (in long term) may affect testosterone levels in serum (Forgács *et al.*, 1998; Cakir *et al.*, 2003). But results of previous studies are very different. Koyu *et al.* (2005a) and Al-Akhras *et al.* (2005) reported that testosterone hormone in rat can decrease in long-term EMF exposure condition. Cakir *et al.* (2003), Forgács *et al.* (1998) and Moon *et al.* (2006) have been reported that long-term exposure to EMFs can affect testosterone levels in rat and increase testosterone levels in serum.

The aim of this study is a review on biological effects of electromagnetic field of cellular phones (950 MHz) on excretion of testosterone and cortisol hormones in long or short terms by Syrian Hamsters.

## MATERIALS AND METHODS

In experimental, it was done the contribution of time period under electromagnetic fields of cellular phone (950 MHz) on Serum testosterone and cortisol of Hamster concentration well. Study was conducted in Shabestar University Laboratory in summer, 2007. Animals were in 3 groups 1) Control 2) 24 male Hamster in separated cages for 10 days and they were under 950 MHz EMF (emitted from Cellular Phone) for 1 h daily 3) 24 male Hamster in separated cages for 50 days and they were under 950 MHz EMF for 1 h daily. Hamsters were maintained under 12 h light/12 h dark cycle in a temperature-regulated (22-23°C) animal room with a continue free access to water and food. At then end of the test, blood samples collection from experimental groups, and the testosterone and cortisol concentration in the serum to be compared with serum concentration of the control group without of any electromagnetic field at them.

### Statistical Analysis

Data collected subjected to analysis of variance and significant differences observed in means subjected to Duncan's multiple range test. All data were analyzed by ANOVA using the general linear model (GLM) procedures of the SAS Institute.

## RESULTS AND DISCUSSION

According to Table 1, the testosterone and cortisol concentrations serum of the Hamsters for three groups, (without of EMF), 10 and 50 days under electromagnetic field of cellular phones to observe.

In this study testosterone and cortisol have clearly increase in the hamsters that have been exposed to the EMF on 50 days (group 3 or long-term group) ( $p < 0.01$ ). But there was no significant difference between testosterone and cortisol hormones of control and short-term exposure groups (group 1, 2) (Table 1).

Table 1: Testosterone and cortisol concentrations in serum exposed to electromagnetic field (950 MHz) in Syrian Hamsters

Experimental groups	Exposure time	Testosterone (ng dL <sup>-1</sup> )	Cortisol (µg dL <sup>-1</sup> )
Control	Without exposure	3.21 <sup>b</sup>	0.39 <sup>a</sup>
Short term exposure	10 day exposure	3.65 <sup>b</sup>	0.58 <sup>a</sup>
Long term exposure	50 day exposure	6.96 <sup>a</sup>	1.05 <sup>a</sup>
CV (%)	-	6.72	25.2

Values with differences superscripts letter(s) are significantly different at  $p < 0.01$

Cortisol rate get significant to increasing for 50 days with 30 min daily beside of 900 MHz electromagnetic field (Koyu *et al.*, 2005b). Sadeghi *et al.* (2006) reported an increasing of Glucose and cortisol for Guinea Pigs besides 50 Hz MF (after 5 day and daily 4 h exposure) they found that the MF to be caused for increasing the stress factors of serum.

According to Koyu *et al.* (2005a) reports, there is a significant difference for the cortisol rate in exposure of 1800 MHz. Also according to Radon *et al.* (2001) results, in present study, long term stress from cellular phones EMFs gets increasing the cortisol rate. Other blood factors of the stress had an increasing in Sadeghi *et al.* (2006) results (such as of Glucose).

Present study results about of cortisol hormone, were as same as Radon *et al.* (2001), Koyu *et al.* (2005a), Sadeghi *et al.* (2006) and Vangeleva *et al.* (2007).

It is shown that testosterone level in serum may increased in exposure to high frequency electromagnetic fields (for example: 950 MHz) in long-term (Moon *et al.*, 2006). But effects of low frequency EMF on serum testosterone level were not significance (Al-Akhras *et al.*, 2005; Zhou *et al.*, 2005).

Present results indicated that long-term exposure to 950 MHz EMF emitted from cellular phones may increased serum testosterone and cortisol level in Syrian hamsters and may affect the reproductive activity and impair endocrine homeostasis and it may cause peripheral effects. But short-term exposure didn't have significance effect on serum cortisol and testosterone level in Syrian hamsters. Present results about testosterone of Syrian Hamsters (were as same as results and findings of influence of 50 Hz magnetic field on the testosterone production of mouse (Forgács *et al.*, 1998), exposed to electromagnetic fields to 50 Hz of rats (Cakir *et al.*, 2003) and influence of long-term Exposure of Rats (Moon *et al.*, 2006). In present study with direct effects of cellular phones EMFs, differences between testosterone levels in control group and treatment groups ( specially in long-term ) is more significance than previous studies (Forgács *et al.*, 1998; Cakir *et al.*, 2003).

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