# THE INFLUENCE OF 50 Hz MAGNETIC FIELD EXPOSURE TO THE HUMAN SERUM

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*Abstract*. One of the possible mechanisms of extremely low frequency magnetic field effects is that magnetic field influences biological systems by increasing free radical life span in organisms. In this paper we intentioned to test this hypothesis. We exposed healthy human serum with and without vitamin A and vitamin E (1 μM, 10 μM, and 100 μM) to different magnetic field inductions. The luminol amplified chemiluminiscence emission show possible window effects for different magnetic field values. Also, the addition of vitamin A or vitamin E cannot restore the control level of chemiluminiscence emission.

*Key words*: ELF magnetic field, free radicals, chemiluminiscence.

## INTRODUCTION

In the research literature there are proposed some mechanisms for understanding the low frequency magnetic fields effects on living organisms.

One of these involves free radicals [1, 4, 5, 6], known for their implications in almost 60 diseases. According to this mechanism [6] an external magnetic field will perturb the spin evolution processes and singlet-triplet transitions. As a consequence, radicals will be longer lived, will be in higher concentrations and the relative probability of radical-molecule reactions (compared with radical-radical) will increase.

The aim of this paper is to test this hypothesis. Our previous work [3] shows that the exposure of human serum to a magnetic field (50 Hz, 0.596 mT) for different periods of time determined a change in the chemiluminiscence emission. From our knowledge, in the literature there are no such experiments that involved human serum.

The human serum reflects the individual life style (smoker, drinker, culinary habit) and in consequence our results had a great variability.

Received July 2005;
in final form October 2005.

ROMANIAN J. BIOPHYS., Vol. 15, Nos. 1–4, P. 99–104, BUCHAREST, 2005

From this reason in this paper we used serum from only two non-smokers healthy donors (woman, 34 years old – F serum and man, 40 years old – M serum).

## MATERIALS AND METHODS

In the first part of the experiments we exposed the serum to a magnetic field with different magnetic inductions: 0.357 mT; 0.596 mT; 1.788 mT and 2.384 mT. The magnetic field was generated from a Helmholtz coil.

In the second part, vitamin A and vitamin E in different concentration (1 μM, 10 μM, and 100 μM) was added to the serum. Then, the serum was exposed to a magnetic field with a magnetic induction that determine a maximum effect in the first part of the experiments.

We utilized for chemiluminiscence determinations the luminol based assay (luminol-$H_2O_2$ system in TRIS HCl buffer) performed on a TD20/20 (USA) Luminometer, $\lambda$ = 430 nm. The reagents used was: ($LH_2$)-luminol (5-amino-2,3-dihydro-1,4-phtalazinedione in DMSO (dimethil-sulfoxide), $10^{-5}$M, Merck, Germany); TRIS buffer (methan-hydroxi-methyl-amino, 0.2 M, pH = 8,4, Merck, Germany); hydrogen peroxide ($H_2O_2$, $10^{-5}$ M, Merck, Germany); human serum. Each sample contains:Control: 200 μl $LH_2$ + 750 μl buffer + 50 μl $H_2O_2$; Sample: 200 μl $LH_2$ + 700 μl buffer +50 μl serum + 50 μl $H_2O_2$; Sample +Vitamin A or E: 200 μl $LH_2$ + 700 μl buffer +50 μl serum + 50μl vitamin + 50 μl $H_2O_2$ .

The antioxidant activity (*AA*) is calculated with the following relation:

$$AA = \frac{I_L - I_0}{I_L} \times 100 \quad (1)$$

Where $I_L$ = luminol chemiluminiscence intensity at 5 seconds; $I_0$ = serum (F or M) chemiluminiscence intensity at 5 seconds.

## RESULTS AND DISCUSSIONS

From Figure 1 we can observe that the maximum effect for the F serum (a 70% increase from control) was obtained at the lowest magnetic field value, 0.357 mT. No effect was observed for the other magnetic inductions.

For the M serum the chemiluminiscence intensity is increasing with the magnetic field value and the maximum intensity was attaint at 2.384 mT (a 71% increase from the control).

In Figures 2 and 3 we illustrated the maximum intensity for F and M serum with antioxidants in different concentrations, exposed for 1 and 2 hours to a magnetic field with 0.357 mT respective 2.384 mT magnetic inductions. We can observe the following:

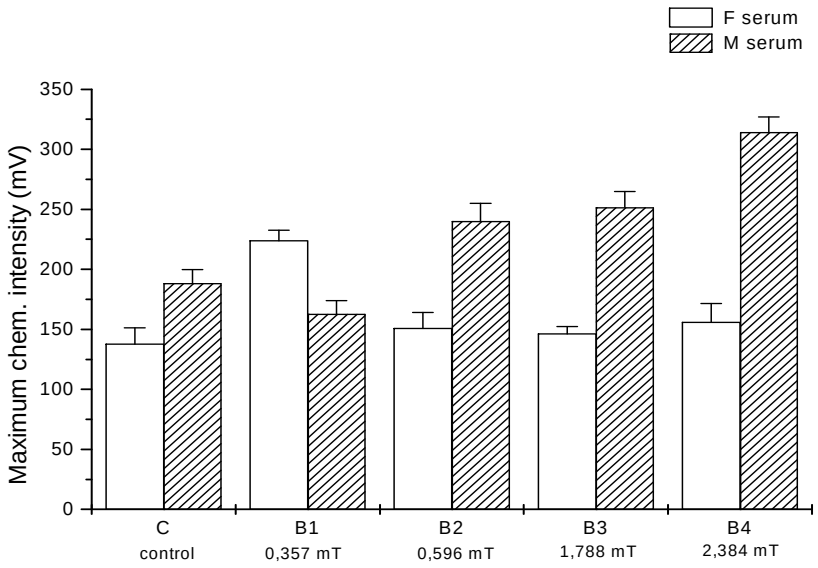


Fig. 1. Maximum chemiluminiscence intensity of female (F) and male (M) serum; exposure time: 1 hour, $n = 3$.

The 2 hours exposure determined a 2.7 fold and a 7.5 fold increased chemiluminiscence emission for F serum respective for M serum.

For F serum:

The 1 h exposure of serum with vitamin A determined an increase of chemiluminiscence emission between 45 – 66% comparative to the serum without vitamin exposed in the same conditions.

For 2 h exposure the chemiluminiscence emission of serum with vitamin A showed a different behavior: a 2 fold decrease comparative with the serum without antioxidants. The maximum intensities maintained at the control level.

The serum with vitamin E shows a similar behavior with the serum with vitamin A. At 1 h exposure time and 1 μM concentration the chemiluminiscence intensity drops under the control level but for the other concentrations the level is similar to the 1 h exposed serum.

For M serum:

Both for the serum with vitamin A and the serum with vitamin E the exposure for 1 and 2 hours determined a decrease of chemiluminiscence intensity, but the values remains greater than the control.

For the serum with vitamin A exposed for 2 h period we can observe that maximum intensity are greater than the chemiluminiscence of the serum exposed 1 hour, suggesting a possible cumulative effect:

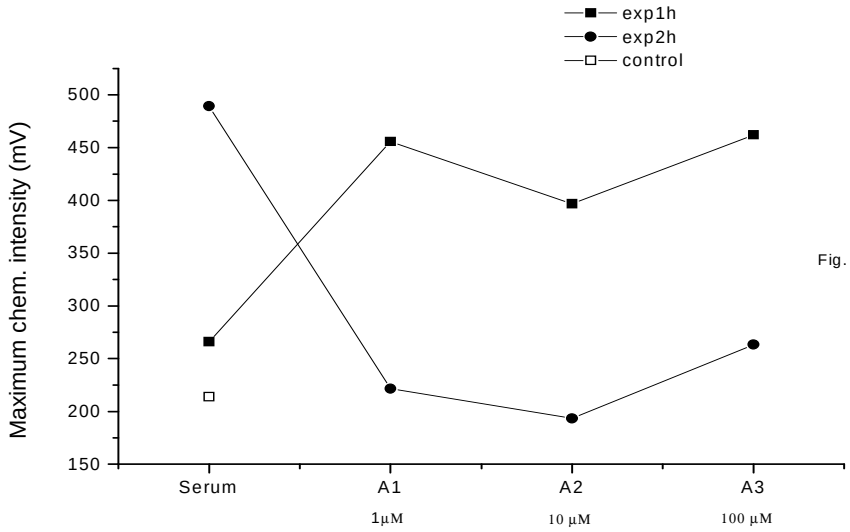


Fig. 2A

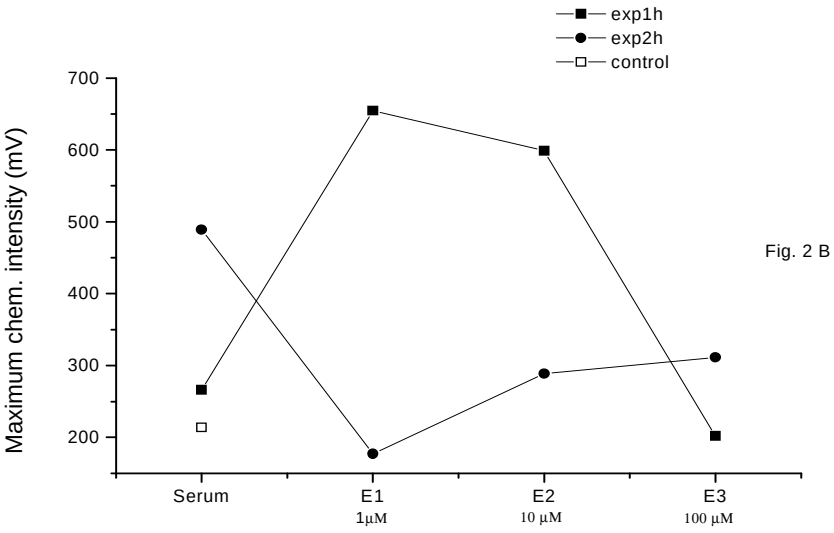


Fig. 2 B

Fig. 2. The variability of maximum chemiluminiscence intensity of F serum exposed to magnetic field ($B$ = 0.357 mT, exposure time = 1 and 2 h) at different concentration of vitamin A (2A) and vitamin E (2B).

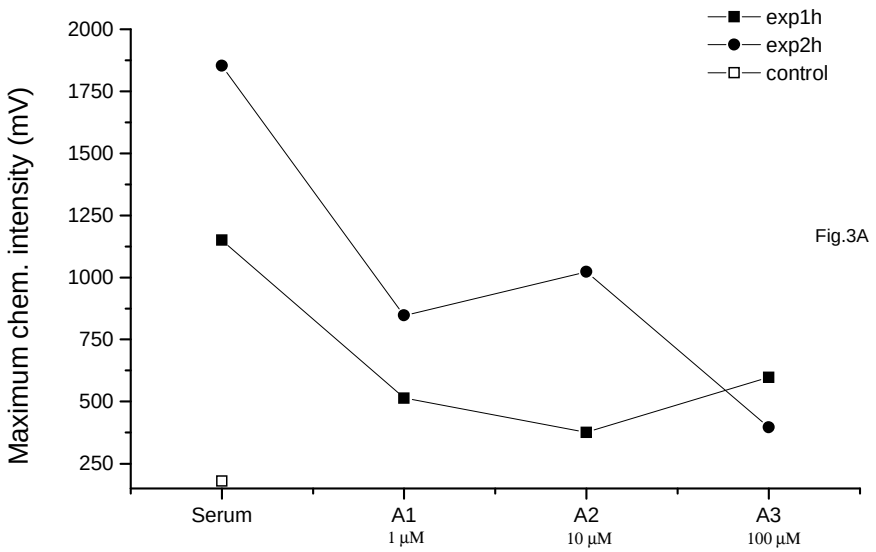


Fig.3A

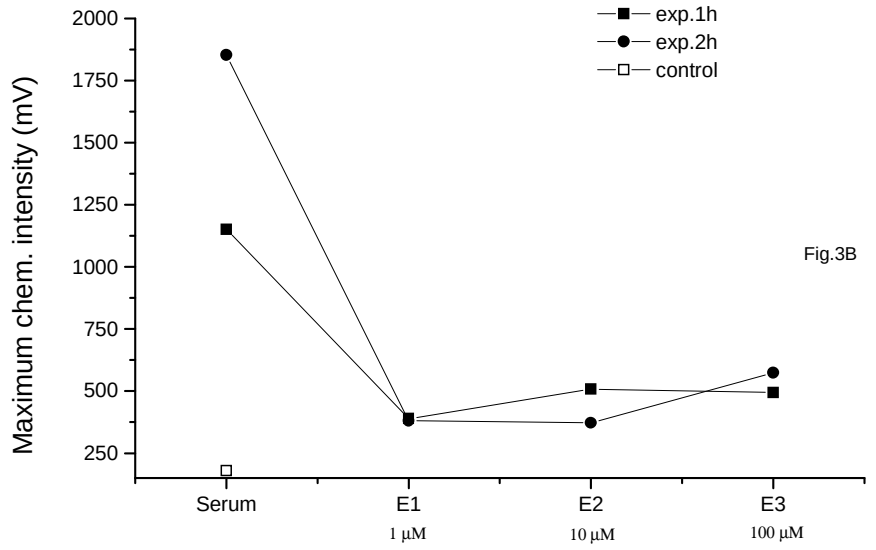


Fig.3B

Fig. 3. The variability of maximum chemiluminiscence intensity of M serum exposed to magnetic field ($B$ = 2.384 mT, exposure time = 1 and 2 h) at different concentration of vitamin A (3A) and vitamin E (3B).

## CONCLUSION

An important conclusion is that the exposure to the magnetic field determines an increased concentration of the free radicals and that the vitamin A and vitamin E at the concentrations used in this paper cannot restore in all situations the chemiluminiscence emission at the control levels, the vitamin A added in the F serum having even a prooxidant effect.

The date from the literature suggests that vitamin A antioxidant activity varies from system to system for reasons that are very poorly understood [2]. The very different behavior of the 2 exposed serum (F and M) is in according to the hypotheses of the "window" type effects [6] of the magnetic fields, in the literature, it is described even an organ or tissue specificity [7].

The understanding of the serum and the serum with antioxidants behavior impose further experiments and the results must be correlated with dates from other experiments types.

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