ELECTROMAGNETIC FIELD INFLUENCE ON SOME ANTIOXIDANT ENZYMES FROM RAT BLOOD SERUM

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Abstract: Wistar rats were treated 6, 13 and 20 days with two type electromagnetic field (EMF): 50Hz and 100Hz, 30 minute daily. It was determined superoxide dismutase and glutathione peroxidase activities in rat blood serum treated with EMF. Confronted by control lot, in both 50Hz and 100Hz EMF treated animals the superoxide dismutase activity is increasing after 6 and 13 day of treatment. At 20 days it was recorded a superoxide dismutase activity inhibition, greater than the 100Hz EMF treatment.
The blood serum glutathione peroxidase activity was stimulated by 50Hz EMF after 6 days and also by 50Hz and 100Hz EMF after 13 day of treatment. The 20 days treatment (long duration) was determined an insignificant inhibition of glutathione peroxidase.

INTRODUCTION

The electromagnetic field (EMF) effects on animal organisms are multiples and complexes [Jitariu, 1987]. EMF are capable to influence various biochemical, biophysical and physiological processes in living cell, affecting animal organs and tissue functions. It was ascertain that the animal treatment with small intensity pulsatile EMF, affect endocrine gland activity [Dimitriu, 1970, Jitariu et al, 1963], glucidic metabolism [Dimitriu şi Artenie, 1977a; Artenie şi Dimitriu, 1980], lipid metabolism [Artenie şi Dimitriu, 1975; Dimitriu et Artenie, 1977b] and protein metabolism [Jitariu et al, 1967; Lazăr, Neaga, 1970].

EMF represents one of the environment factor that influence animal organism, which conduct to stress. It is known that a powerful stress is associates with metabolic modifications, including the entire complex of redox processes which facilitate the adaptable processes of the living organisms. An important link in oxide-reducing homeostasis maintenance is due to cell antioxidant enzymes, like catalase, peroxidase, superoxide dismutase, glutathione peroxidase etc.

In this paper it was determined the superoxide dismutase and glutathione peroxidase response from rat blood serum treated with different EMF intensity on precise periods of time.

MATERIALS AND RESEARCH METHODS

The experiments were realized on white rats (Wistar). Even if the animal’s conditions were maintained constant allover the experiment, the weight had an insignificant modification. Both before and during the experiment the rat were benefited by complex food (cereals, meat with bird bones, carrots, grease, minerals, microelements, 15% protein, 6% grease, 2% cellulose, vitamins: A = 5500Ui/Kg, B1 = 2mg/Kg). The food composition maintenance is important for metabolism, any recorded modification at metabolic level is due to the influence of the follow factor. The EMF were generated with Magnetodiaflux device, with 2 circular coil by 29 cm in diameter. The animal was immobilized in a plastic cylinder, with many holes for aeration, to provide a precise irradiation. It was used two type of EMF: 50Hz – 2,7mT and 100Hz – 5,5 mT. For surety, the electromagnetic induction was measured with a digital teslameter. The EMF irradiation was applied 30 min/day during a period of 20 days. The device was set to generate the EMF intermittently with 0,5-2s break intervals. It was treated 36 rats which are divided in 3 lots of 12 rats (4 were the control and 8 were treated: 4 with 50Hz and 4 with 100Hz). Even the control animals were immobilized in the plastic cylinder but without irradiation. This procedure was necessary to eliminate possible modifications due to the immobilization stress effect which is similar with that induced by EMF. During the 20 days, at each 7 day 12 rats were killed (4 from the control and 8 form the treated lots). The serum from obtained blood was used for analyzing the superoxide dismutase and glutathione peroxidase activities.

Superoxide-dismutase activity was determined spectrophotometrically measuring the percent of the superoxide-dismutase-induced inhibition of Nitro Blue Tetrazolium (NBT) reduction by the superoxide radicals resulted in the medium of reaction by riboflavin photoreduction [Winterbourn et al., 1975]. The NBT reduction was followed at 560 nm using Metertek SP830 spectrophotometer. The rate of NTB reduction in the enzyme absence was taken as the reference value. One unit of superoxide-dismutase represents the quantity of enzyme which produces 50% inhibition in the standard conditions.

Glutathione peroxidase was assayed by method of Fukuzawa and Tokumura (Artenie et al., 2007). This method is based on the reaction between excess reduced glutathione (G-SH) left in the incubation medium and 5,5'-ditiobis-2-nitrobenzoic acid which gives an yellow (complex) product. The color intensity is measured at 412 nm. The difference between the initial and final amounts of reduced glutathione left in the assay medium is directly proportional with the glutathione peroxidase activity. One unit of glutathione peroxidase activity is defined as the amount of enzyme which oxidizes one micromole of G-SH per minute.

Statistical analysis of the enzyme activities was performed using the Student test [Văleanu, Hâncu, 1990], at the 0.05 level of significance.

RESULTS AND DISCUSSIONS

The research made reveled an influence in superoxide dismutase and glutathione peroxidase activity from sanguine serum in treatment with low intensity EMF.

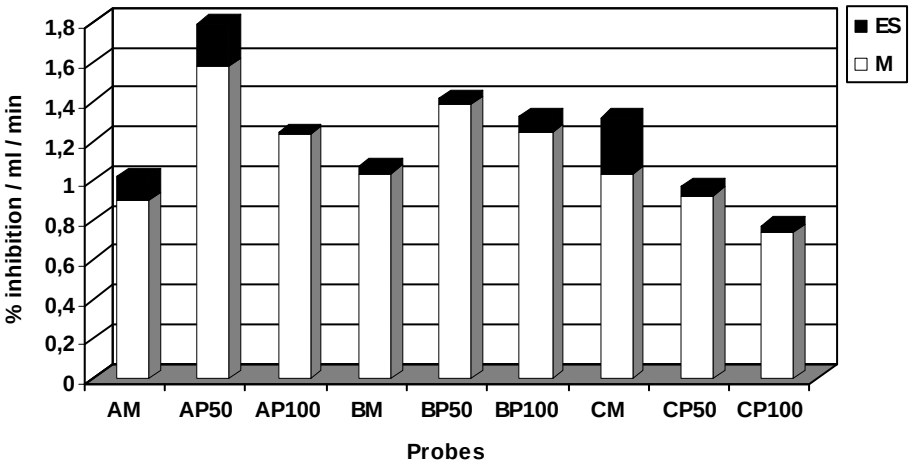

Fig.1. Control and treated rats sanguine serum superoxide dismutase activity variation (% inhibition/ml/min) under intermittent EMF influence. (M-superoxide dismutase average activity; ES-standard error; AM-control rats from lot A; AP50-50Hz intermittent EMF treated rats 30 min/day, 6 days long; AP100-100Hz intermittent EMF treated rats 30 min/day, 6 days long; BM-control rats from lot B; BP50-50Hz intermittent EMF treated rats 30 min/day, 13 days long; BP100-100Hz intermittent EMF treated rats 30 min/day, 13 days long; CM-control rats from lot C; CP50-50Hz intermittent EMF treated rats 30 min/day, 20 days long; CP100-100Hz intermittent EMF treated rats 30 min/day, 20 days long)

According to fig.1, the superoxide dismutase activity was modified by one lot to another, in concordance with EMF intensity and treatment duration. The superoxide dismutase activity was increased at rats treated 6 days both with 50Hz and 100Hz EMF comparative to control lot. Even if the superoxide dismutase activity increasing is evident (74,54% up to control) at the 50Hz treated rats, it is very little statistic significant. In case of 100Hz EMF, the increasing activity (36,12% up to control) is statistic significant.

The extending treatment period from 6 to 13 days is also associates with an increasing superoxide dismutase activity. Compare with the control lot, in this case, the 50Hz EMF cause a

greater increasing (34,12%) of superoxide dismutase activity, but statistic is insignificant, while 100Hz EMF stimulate only 19,88%, a little statistic significant.

The treatment of rats with the two types of EMF for 20 days long conducts to a decrease of superoxide dismutase activity. The inhibition of superoxide dismutase is low (10,42%) after using 50 Hz EMF and very strong (28,57%) in case of 100Hz EMF. The 100Hz EMF effect has an obvious limit of statistic significance ($0,001<p<0,01$).

The control and the treated rat's blood serum glutathione peroxidase activity is show in fig.2.

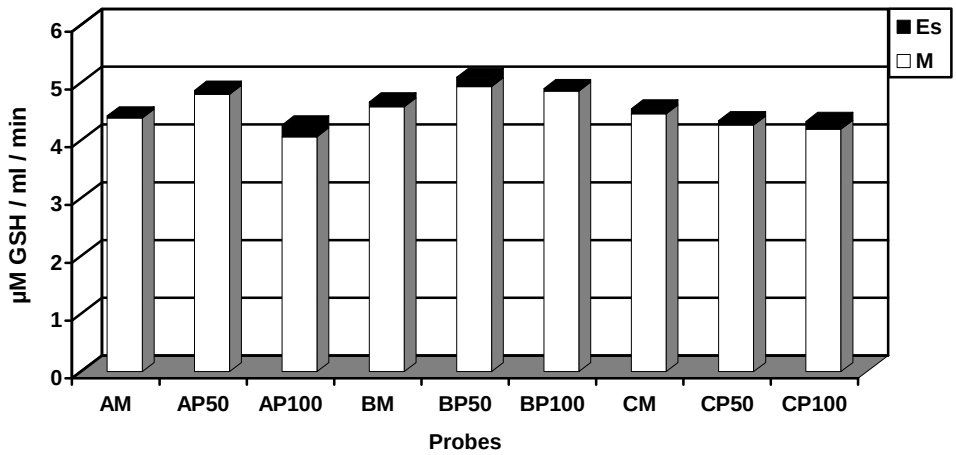

Fig.2. Control and treated rats sanguine serum glutathione peroxidase activity variation (µM GSH/ml/min) under intermittent EMF influence. (M-glutathione peroxidase average activity; ES-standard error; AM-control rats from lot A; AP50-50Hz intermittent EMF treated rats 30 min/day, 6 days long; AP100-100Hz intermittent EMF treated rats 30 min/day, 6 days long; BM-control rats from lot B; BP50-50Hz intermittent EMF treated rats 30 min/day, 13 days long; BP100-100Hz intermittent EMF treated rats 30 min/day, 13 days long; CM-control rats from lot C; CP50-50Hz intermittent EMF treated rats 30 min/day, 20 days long; CP100-100Hz intermittent EMF treated rats 30 min/day, 20 days long)

The blood serum glutathione peroxidase activity was not uniform influenced by EMF treatment. Both after 6 days and after 13 days of treatment with 50Hz EMF it is recorded an activity increase of 9,36% and 7,60% compare with the control lot's level enzyme activity. However, only the glutathione peroxidase activity at 6 days is statistic significant. 100Hz EMF has a little inhibition effect (7,42%) at 6 days and a little stimulation effect (5,94%) at 13 days. The 100Hz EMF is provided by statistical computation.

At 20 days it was recorded a little inhibition at a same proportions (4,35% and 5,90%) both at 50Hz and 100Hz EMF.

Drawing a parallel between superoxide dismutase and glutathione peroxidase activity in rat blood serum, it was observed that at same treatments appears differences in both enzyme activities.

Firstly, both rats of lot A and lot B the activity variation of superoxide dismutase is more pronounced comparative with the dynamics of glutathione peroxidase activity. Also at lot C where the treatment has last 20 days, both enzymes activity was inhibited in different proportion by 50Hz and 100Hz EMF.

Activity modifications of some enzymes under EMF influences were also decelated by other authors. In this way, was evidenced a decreasing sanguine and serum alpha-amylase at pigeon under low intensity EMF [Dimitriu şi Artenie, 1977b]. Alpha-amylase activity from pigeon brain, liver and pectoral muscle is insignificant modifying under the same EMF [Artenie şi Dimitriu, 1980].

In case of the antioxidant enzymes was found a muscle catalase and peroxidase significant increase at 5 days at EMF treated pigeon, also a significant decrease of the peroxidase in liver. If the pigeon treatment duration is increasing to 10 days, than it is recording a stimulation muscle catalase activity and inhibition sanguine catalase. The peroxidase activity is higher in liver and blood in EMF animal treatment.

CONCLUSIONS

EMF treatment was stimulated the superoxide dismutase activity at rats. Confronted by control lot, in both 50Hz and 100Hz EMF treated animals the superoxide dismutase activity is increasing after 6 and 13 day of treatment. In case of the 50Hz EMF treatment, the superoxide dismutase activity has a higher value than the 100Hz EMF treatment.

At 20 days it was recorded a superoxide dismutase activity inhibition, greater than the 100Hz EMF treatment.

The blood serum glutathione peroxidase activity was stimulated by 50Hz EMF after 6 days and also by 50Hz and 100Hz EMF after 13 day of treatment.

The 20 days treatment (long duration) was determined an insignificant inhibition of glutathione peroxidase.

Superoxide dismutase and glutathione peroxidase activity in rat's sanguine serum was modified in same manner.

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