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Detection of Long Term Microwave Radiation as a Probable Oxidative Agent in Rat

[1]P. Eshratabadi, [2]M. Sedehi Esfahani, [3]Z. Salarvand and [2]S. Khadivi
[1]Department of Food and Agriculture, [2]Biologhcal Research Center,
[3]Department of Chemistry, Institute of Standard (ISIRI), P.O. Box 31585-163, Karaj, Iran

Abstract: The aim of this study was to assess the any probable oxidative effect of long term microwave radiation, by determination of serum hydroxybutyrate in rat. Eighty experimental rats in 5 groups each 16 (8 males and 8 females), 4, treated and one control were exposed to microwave radiation (2450 MHz with power density of 1 and 10 mw cm^{-2}), for a period of 1 year. The first 2 treated groups were exposed to microwave radiation at power density of 1 mw cm^{-2} in different period (30 min for one group and 5 min for another one), daily. Next 2 treated groups were exposed to microwave radiation at power density of 10 mw cm^{-2} in different period (30 min for one and 5 min for another group), daily. Control group were kept in analogous conditions without any microwave exposure. Animals were observed daily and body weight and food and water consumption was assessed weekly too. In the end of study the blood samples were taken from the heart of animals after 12 h fasting under ether anesthesia and 777 serum hydroxy butyrate analysis was performed on the blood samples by enzymatic method. According to the test result and statistical method, the level of the hdrb in group F of female and group G of male were significantly increased in com parison with that of control group, but increasing of hdrb in other treated groups was not significant in comparison with control. So, it is suspected that long term microwave exposure, can be a probable agent for oxidative damage in rat, that would be considered.

Key words: Microwave, rat blood, electromagnetic effect, oxidative damage

INTRODUCTION

The biological and health effects of electromagnetic fields have been the subject of active researches in recent years. Several studies have suggested possible bioeffects of magnetic fields on human health (Sienkiewicz, 1998; Day, 1999; Stuchly, 2002; Lacy *et al*., 1998).

Several investigations have demonstrated an increase in childhood leukemia and other related diseases in children from populations exposed to magnetic fields (Thomson *et al*., 1988; Green *et al*., 1999). More studies have been performed the sub chronic effects of magnetic fields exposure on animals *in vivo* and *vitro* (Ray and Behari, 1990; Koveshnikova and Antipenke, 1988; Chater *et al*., 2006; Andrea *et al*., 1986).

According to the some reports, the magnetic fields exerted preponderate controlling influence on thermoregulation, metabolism and hematology in animals (Bonhomme *et al*., 1998).

Considering the lack of consensus on the oxidative effects of 2450 MHz microwave exposure, this study aimed to detect the possible effect of chronic exposure to 2450 MHz microwave radiation at power density of 1 and 10 Mw cm^{-2} on hydroxy butyrate in rat.

This trial is presenting any probable oxidative effect of microwave radiation, through the determination of serum hydroxybutyrate (Hdrb) as a hydroxil radical in rat, after a period of one year .

MATERIALS AND METHODS

Animals: For this study 80 sprague Dawley rats with 5 week age were used for a period of one year. The animals were housed individually in polycarbonate cages under standard conditions with free access to tap water and standard food (Boever, 1983). The rats were devided to 5 group, each containing 16 rats (8 male and 8 females), as follows:

Group D and E: Exposed to microwave radiation with power density of 1 mw cm^{-2} for 30 min. daily for group D and 5 min daily for group E.

Group F and G: Exposed to microwave radiation with power density of 10 mw cm^{-2} for 30 min daily for group F and 5 min daily for group G.

Group H: As a control group were kept under the same condition without any microwave exposure.

Corresponding Author: Z. Salarvand, Department of Chemistry, Institute of Standard (ISIRI), P.O. Box 31585-163, Karaj, Iran

Records and control: The animals were weighed before experiment and weekly. The food and water consumption were controlled weekly too. Any clinical observation were noted and recorded.

Hdrb analysis: In the end of the study the blood samples were taken. From the heart of animals after 12 h fasting (water available) under ether anesthesia. The level of Hdrb of blood serums was measured by kinetic enzymatic method.

This method is based on the oxidation of D-3 hydroxybutyrate (hdrb) to acetoacetate by the enzyme 3- hyroxybutyrate dehydrogenase.

Concomitant with this oxidation the cofactor NAD^+ is reduced to NADH (Li *et al*., 1980; Carl, 1994; Bowers and McComb, 1966).

Statistical analysis: Statistical evaluation of the mean equality of control and treated groups was made by the appropriate one way analysis of variance (anova) Technique followed by a multiple comparison.

The one way anova was applied using the F distribution to assess significance at the level of 0.05.

RESULTS AND DISCUSSION

General observation: There was no abnormality observed in treated and control groups.

Growth, water and food consumption: According to the results, percentage of body weight and food consumption was decreased, but the percentage of water intake was increased in treated groups in comparison with control. (Koveshnikova and Antipenke, 1988).

The level of hdrb: Figure 1 and 2 indicates mean differences of serum hdrb in male and female groups according to the statistical method the level of serum hdrb

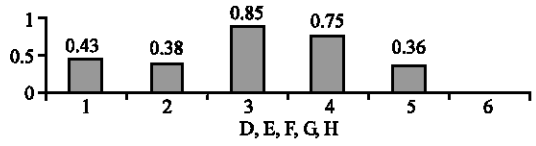

Fig. 1: Blood hdrb (mmol L^{-1}) level in male groups

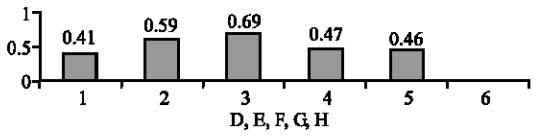

Fig. 2: Blood hdrb (mmol L^{-1}) level in female groups

in group f (female) and group g (male) was significantly increased ($p<0.007$ for group f and $p<0.001$ for group g) and the increasing of serum hdrb in other groups was not significant that means long term microwave in comparison with control group, exposure with 10 mw cm^{-2} can be a probable agent for oxidative damage that would be considered (Ray and Behari, 1990; Hawley, 1991; Yoshida *et al*., 2003; Canizares-Macias *et al*., 2004; Dacha *et al*., 1993; Gorczynska and Wegrzynowicz, 1989).

CONCLUSION

Evidence Supports that long term microwave exposure at incident power density of 10 mw cm^{-2} daily can increase the Serum hdrb level, with OH radical in animals, that means microwave radiation at power density of 10 mw cm^{-2} is a probable indicative of the oxidative damage, that could be considered.

We also investigated that variation of the hdrb in treated rats exposed to microwave radiation at power density of 1 mw cm^{-2} have not been significant.

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