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Protective role of sesame oil against mobile base station-induced oxidative stress

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ABSTRACT

The present study was undertaken to shed the light on the environmental threats associated with the wireless revolution and the health hazards associated with exposure to mobile base station (MBS). Besides, studying the possible protective role of sesame oil (SO) as an antioxidant against oxidative stress. Therefore, the present work was designed to study the effect of chronic exposure to electromagnetic radiations (EMR), produced by a cellular tower for mobile phone and the possible protective role of sesame oil on glutathione reductase (GSH-Rx), superoxide dismutase (SOD), catalase (CAT), total testosterone and lipid profile (total cholesterol (Tch), triglycerides (TG), low density lipoprotein cholesterol (LDL-c) and high density lipoprotein cholesterol (HDL-c) in male albino rats. Rats were arranged into four groups: the control unexposed, the exposed untreated and the exposed treated groups (1.5 and 3 ml oil). Exposed groups were subjected to electromagnetic field at frequency of 900 MHz, for 24 h/day for 8 weeks, at the same time both treated groups were supplied with oral injection of sesame oil three times per week. At the end of the experiment, blood samples were obtained for determination of the above mentioned variables in serum. The results obtained revealed that TG and testosterone were raised significantly over control in all groups and the significant increase in oil groups occurred in dose dependent manner. SOD and CAT activities were reduced significantly in exposed rats than control and increased significantly in sesame oil groups as the dose of oil increased. Total cholesterol only showed remarkable reduction in the group treated with 3 ml sesame oil. Also, in this latter group, significant elevation of GSH-Rx was recorded. Changes in serum HDL-c and LDL-c followed an opposite trend in exposed and sesame oil groups reflecting their affectation by EMR or sesame oil. In conclusion, all results of the current study proved that sesame oil can be used as an edible oil to attenuate the oxidative stress which could be yielded as a result of chronic exposure to EMR.

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1. Introduction

Recently, much attention has been directed towards the recognition of the potential health risks of radiofrequency electromagnetic waves (RF EMWs) emitted by mobile phones (Djeridane, Touitou, & de Seze, 2008). Within the past twenty years, several studies indicated a linkage between the exposure to electromagnetic radiation (EMR) and serious health problems. Electromagnetic field might produce a variety of adverse in vivo effects such as headaches, sleep disturbances, modifications of electroencephalographic activity as well as alterations of biological functions in human and animals (Mossmann & Hermann, 2003; Repacholi, 2001).

Electromagnetic radiation (EMR) or radiofrequency fields of cellular phones may affect biological systems by increasing free radicals, which appear mainly to enhance lipid peroxidation and by changing the antioxidant defense systems of human tissues, thus leading to oxidative stress (Nisarg, Kavindra, & Agarwal, 2009; Ozguner et al., 2005).

However, many studies referred another mechanism for biological disturbances; they have demonstrated that RF-EMWs from commercially available cell phones have non-thermal effects (Friedman et al., 2007; Leszczynski et al., 2002) including effects on mitochondria, apoptosis pathway, heat shock proteins, cell differentiation and DNA breaks (Leszczynski et al., 2002; McNamee et al., 2003; WHO, 2006).

RF-EMWs might disturb ROS metabolism by increasing production of ROS or by decreasing antioxidant enzyme activity. Chronic exposure to RF-EMW decreases the activity of catalase, superoxide dismutase (SOD) and glutathione peroxidase (GSH-Px), and thus reduces the total antioxidant capacity (Nisarg et al., 2009). Other study carried out by Kesari, Kumar, and Behari (2011) also demonstrated a decrease in GSH-Px and SOD with an increase in catalase. Irmak et al. (2002), on the other hand, showed that SOD activity increased in serum of rabbits exposed to EMR of digital GSM mobile telephone (900 MHz) whereas, CAT and GSH-Px were not changed (Kesari et al., 2011).

Nowadays, there is an increasing interest in discovering the protective biological function of natural compounds contained in dietary plants due to safe use, their anti-oxidative properties and their possible roles in intra and extracellular defense against oxygen radicals and lipid peroxides in response to oxidative stress. Among of these natural products, sesame oil (SO) which becomes a matter of choice for our investigation. SO was regarded in past as a daily nutritional supplement used to increase cell resistance to lipid peroxidation since it contains several antioxidants and chemo preventive agents such as tocopherol (Fukuda, 1990), sesamolin and sesaminol (Kang, Katsuzaki, & Osawa, 1998) and sesamin (Chavali, Utsunomiya, & Forse, 2001).

Hence, this investigation was undertaken to study the health hazards associated with exposure to electromagnetic waves of mobile base station for 8 weeks and to determine the effect and the possible defense mechanisms of sesame oil on oxidative stress induced by this non-ionizing radiation.

2. Material and methods

Thirty two adult male albino rats (*Rattus rattus*), weighing about 150–170 g were used in this study. Animals were randomly arranged equally into four groups as follows: Control unexposed group, EMR exposed group, EMR exposed + sesame oil-treated groups (1.5 ml and 3 ml). Electromagnetic radiation was applied to exposed groups for 8 weeks. Rats were obtained from the animal house of the Nuclear Research Center, housed in plastic cages, given standard rodents feed and tap water *ad-libitum* and kept under constant conditions. The treated groups were received sesame oil orally (1.5 or 3 ml) using a stomach tube three times/week according to Hsu et al. (2004).

The experimental groups were exposed to electromagnetic radiation emitted from a cellular tower (base station) for mobile phone constructed on a roof of a building in Cairo at frequency of 900 MHz, power density of 0.5 mW/cm^2 at the site of exposure with distance of 8 m in front of the antenna, 24 h/day for 8 weeks. The field strength emitted by the tower was measured with isotopic probe specified for measuring high frequency and the compartment shaped to standard IEEE C 95, 1995 (N. M. El-Abiad, 2002). At the end of experiment the animals were fasting overnight, transferred to the laboratory where blood samples were collected by decapitation for laboratory assessment of the studied parameters.

Blood was allowed to clot at 37 C° for 30 min, centrifuged for 15 min at 5000 rpm, sera were separated and kept frozen at −20 °C until analysis. Serum levels of total testosterone, Tch, TG, LDL-c, HDL-c besides the activities of GSH-Rx, CAT and SOD were measured to evaluate the changes of the antioxidant status.

Tch and TG were estimated by using enzymatic colorimetric method of Allain et al. (1974) and Fossati and Prencipe (1982) respectively. Total testosterone hormone was assayed by using radioimmuno-assay kits supplied by Diagnostica Co., Los Angeles based on the method of Maruyama et al. (1987). Colorimetric determination of HDL-c was done using kits of Bio-Merieux Marcy-L-Etoile/France. LDL-c was calculated according to formula of Friedwald, Levy, and Fredrikeson (1972).

Serum GSH-Rx, SOD, and CAT activities were measured colorimetrically using commercial kits according to Goldberg and Spooner (1993), Nishikimi, Roa, and Yogi (1972) and Aebi (1984) respectively.

2.1. *Statistical analysis*

Data are expressed as means ± SE, student *t*-test was used to make pair wise comparison between the treatments according to Sendecor and Cochran (1989). The statistical significance was set at $p < 0.05$.

3. Results

Changes in serum lipid fractions in the four experimental groups are expressed in Table 1. The only significant decrease