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Letter to the Editor

Comments on the paper by M. Barteri, A. Pala, S. Rotella, Structural and kinetic effects of mobile phone microwaves on acetylcholinesterase activity, Biophys. Chem. 113 (2005) 245–253

In the paper *M. Barteri, A. Pala, S. Rotella, Structural and kinetic effects of mobile phone microwaves on acetylcholinesterase activity* which appeared in March 2005, vol. 113 pp. 245–253, the authors studied the possible effects of radiofrequency (RF) electromagnetic fields emitted by GSM cellular phone on an enzymatic activity. The authors maintain that RF radiation could irreversibly affect structural and biochemical characteristics of *acetylcholinesterase*. In this letter we maintain that these results could not be considered scientifically significant enough since the RF exposure modalities do not meet the current recommended minimal requirements for quality exposure assessment.

In the last years, an important debate on quality assurance in experiments to evaluate the effects of electromagnetic fields has been assessed [1–3]. These considerations were related to the fact that, in the past, several studies and results were not reproducible, due to an inaccurate characterization of the exposure conditions.

In our opinion in the cited paper the basic requirements for a reliable RF exposure of in vitro "biological" samples are not taken into account. Moreover neither the experimental nor the theoretical procedure applied to evaluate the SAR have been explained, so that some comments and uncertainties over the text could be raised:

- The instrument PMM 8053 is usually adopted only for broad-band environmental measurements since it is not able to distinguish different frequency contributions (due to all the EM sources present around the experimental environment). Moreover it cannot be used at 5 cm distance from the source, i.e. in the near field region of the antenna (reactive region), since the probe can greatly perturb the radiating properties of the antenna locally modifying the electric field measured [4,5].
- It seems that the authors used the electric field measured in the environment for SAR calculations. It must be stressed that the SAR is the reference quantity, related with the internal E field, rigorously defined for RF and microwave dosimetry [3]. Different expressions can be derived to relate SAR to measurable quantities, such as electric field induced inside the medium, increase of temperature and current density. The relationship between the SAR and the electric field induced inside the medium is:

$$SAR(r) = \frac{\sigma(r)|\vec{E}_{\mathrm{ind}}(r)|^2}{\rho}$$

where σ is the tissue conductivity, ρ is the material density and E represents the value of internal E field, and it gives a specific local value. SAR inside the medium is strongly inhomogeneous, being constant σ and ρ , even when the incident field is uniform, depending on the shape and dielectric properties of the sample holder and on the other laboratory equipment.
- "It is known that the emission intensities of commercial mobile phone handsets are different."—The emission intensities of commercial mobile phones are rigorously defined by the European Telecommunication Standard Institute (ETSI) for all platforms (from the oldest NMT, TACS, … to the last phone generations), for each frequency, for each level of emission, with specific tolerances. Significant differences can be measured in terms of SAR due to different emission modalities related to antenna models and phone shapes [6].
- Communication protocols establish that starting any connection between the mobile phone and the network, the power from the mobile unit is emitted at the maximum allowable level (specific for any platform) and then the power level can be decreased depending on the distance from the base transceiver stations (BTS) and on the quality of the connection (APC—Automatic Power Control algorithm) [7]. During a regular call, the phone can vary the power (in a range of 30 dB), the frequency band (900 or 1800 MHz) and inside a specific band the frequency (frequency hopping). This procedure is the same for incoming and outgoing calls. Even if the mobile device is kept stationary, in a good location from the point of view of the base station, the power and frequency of emission change continuously. As a consequence the differences in the emitted power patterns are only related to chance. A commercial phone can be used as a source in exposure systems only employing special SIM cards, that control the emitted power with specific codes, and/or BTS simulators in order to guarantee a controlled value of emitted power at a defined value of frequency.
- Temperature measurements in presence of electromagnetic fields require particular care and use of special

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thermometers because of electromagnetic compatibility and interference problems. In the cited paper the modalities of measuring temperature differences of 0.2 °C are not clear.

In conclusion in the paper of Barteri et al., a "controlled exposure system" and the characteristics of the exposure to RF fields cannot be identified. It is impossible to know effectively the exposure modality, the frequency and the signal characteristics, the dose, etc. Moreover, the instrument used to characterize the field has been used inappropriately for the modality of the measurements.

For these reasons it is desirable that a good quality exposure assessment should be performed in order to let such results to be considered in scientific reviews as those considered in the WHO international EMF Project [2].

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