EXPERIMENTAL INVESTIGATIONS ON THE BIOLOGICAL FREE RADICAL PRODUCTION

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Fundamental experiments were carried out to investigate the effect of the microwave EMF on the biological free-radical production. For this purpose, a high intensity 2.45 GHz microwave exposure system, which consists of a high power magnetron tube, dielectric lenses and a horn antenna, was developed. This system enables an efficient beam-forming exposure and effective EMF irradiation concentration on the target tissues.

First, the microwave exposure system (2.45 GHz continuous wave) and typical excised animal tissues were used for the preliminary investigation. The irradiated EMF on the tissues was estimated by the actual electric field strength measured with a 3-dimensional isotropic electric field probe. In addition, a numerical analysis based on the FDTD method was also employed for accurate estimations of the EMF on the tissues. The temperature of the tissues was also measured as a possible factor that could affect the free radical production. The X-band Electron Spin Resonance (ESR) Spectrometer was employed for detecting and identifying free radicals excited on the irradiated tissues. As a result, the radical productions due to the high-level microwave exposure were clearly observed in the range above a certain level of absorbed microwave energy. Furthermore, it was found that there is a strong relation between the radical production and the tissue temperature.

Next, the further experiments for the hydroxyl radicals that treat cultured human fibroblast cells were performed. We used the ultra violet (UV) rays applied to the purpose of control of the hydroxyl radical excitation. Here, the X-band ESR and the fluorescence probe method were adopted to estimate the radical productions. In this case, we performed three ways of irradiation to the cultured cells. The first one was irradiation with UV rays (UVA). The second one was the irradiation with 2.45 GHz continuous wave by using the developed exposure system (the output power: 50 W, keeping the temperature of tissues under 40 degrees Celsius). And the last one was the case of irradiation with high power pulse wave (peak power: 1 kW, pulse width: 1 msec, the duty ratio: 10 %). In the case of irradiated with UV, the radical productions in the cells are clearly observed. However, no radical excitation was observed in the cells irradiated by microwave both in the case of CW and pulse, provided that the temperatures of fibroblast cells did not exceed 42 degrees Celsius. There is no difference in the results between the X-Band ESR estimation and the fluorescence probe method.

Finally, we give a summary and conclusions.