Interaction between weak low frequency magnetic fields and cell membranes

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Abstract

The question of whether very weak low frequency magnetic fields can affect biological systems, has attracted attention by many research groups for quite some time. Still, today, the theoretical possibility of such an interaction is often questioned and the site of interaction in the cell is unknown. In the present study, the influence of extremely low frequency (ELF) magnetic fields on the transport of Ca^{2+} was studied in a biological system consisting of highly purified plasma membrane vesicles. We tested two quantum mechanical theoretical models that assume that biologically active ions can be bound to a channel protein and influence the opening state of the channel. Vesicles were exposed for 30 min at 32 °C and the calcium efflux was studied using radioactive ^{45}Ca as a tracer. Static magnetic fields ranging from 27 to 37 μT and time varying magnetic fields with frequencies between 7 and 72 Hz and amplitudes between 13 and 114 μT (peak) were used. We show that suitable combinations of static and time varying magnetic fields directly interact with the Ca^{2+} channel protein in the cell membrane, and we could quantitatively confirm the model proposed by Blanchard. Bioelectromagnetics 24:395–402, 2003.