PREFACE

Extremely low-frequency pulsed electromagnetic fields (ELF-PEMF) are omnipresent in our environment due to the rise in industrial activity, transmission lines, and household applications of electrical and electronic devices. A wider range of electrical and electronic device-generated magnetic fields are considered safe. Numerous studies have been done to look into the potential health impacts of long-term ELF-PEMF exposure (≥ 1 h/day). However, the scientific evidence is mixed, and more research is needed to establish conclusive findings for exposure duration (≤ 1 h/day). The biological effects of magnetic fields primarily depend on magnetic flux density, frequency, and duration. Moreover, biological effects can be divided into thermal and non-thermal, which cause membrane depolarization, excitation, and electrostimulation. The World health organization (WHO) also considers the rising electromagnetic fields in the environment a potential health concern worldwide. However, some studies have also reported the applications of extremely low frequency (ELF) fields for treating neurological, muscle, and cancer disorders. ELF-PEMF is a non-invasive, cost-effective therapeutic technique that uses low-intensity, low frequency magnetic fields for treatment of various diseases.

We have designed, fabricated, characterized, and applied uniform magnetic flux densities for bioelectromagnetic studies under *in vivo* and *in vitro* conditions. The computational simulation was performed on ANSYS electromagnetic suite (18.0) to determine the magnetic flux densities and behaviors of magnetic flux lines. The effects of ELF-PEMF on cell lines (C6, RFP-L929, A549, MCF-7, and HepG2) as well as on behavioral (spontaneous alternation, anxiety, motor coordination, and locomotor activity) and biochemical parameters (AST, ALT, bilirubin, serum creatinine, and CK-MB) of rats were studied under *in vitro* and *in vivo* conditions, respectively, using the custom-made

monoaxial Helmholtz coil. The ELF-PEMF effects on various behavioral, biochemical, and histological parameters were performed to determine the onset of harmful effects at early stages; however, no harmful effects were incidentally observed under the present experimental conditions. Additionally, we have devised a novel therapeutic approach to kill cancer cells. Results have also shown that the magnetic field noticeably induced cell death in lung adenocarcinoma (A549) cells under *in vitro* conditions.

The magnetic field may provide a novel non-invasive approach to cancer treatment and thus offers advantages over other methods to increase patient safety. The magnetic field treatment can also be supplemented by metal nanoparticles for drug delivery, magnetically modified scaffold for wound healing, and peripheral nerve injury. Further studies must determine the exact molecular mechanism for such therapeutic purposes.

Keywords:

ELF-PEMF, Spontaneous alternation, Anxiety, A549, MCF7, C6, RFP-L929, AST, ALT, Ck-MB.