§8. Effects of Strong Magnetic Fields on Biological, Physical and Chemical Processes

Ueno, S., Iwasaka, M. (University of Tokyo)

The biological effects of DC, or static, magnetic fields have been poorly understood. Recognition of the role of the diamagnetic, paramagnetic and ferri- or ferro-magnetic materials in the body helps in unraveling the underlying mechanisms of bioeffects. This paper focuses on the effects of intense static magnetic fields on the behavior of diamagnetic water and paramagnetic oxygen. The effect of strong magnetic fields on the embryonic development of frogs, the regulation of peripheral blood circulation and skin temperature in mice, blood coagulation and fibrinolytic processes, and other biochemical reactions are also discussed.

1. Parting of Water by Magnetic Fields (Moses Effect). When studying the properties of diamagnetic fluids in static magnetic fields up to 8T we observed the phenomena that the surface of the water was pushed back by magnetic fields of higher gradients. A simple calculation shows that the magnetic force acting on 100 ml of water at 20∞C is 0.288 Newton, i.e. 1/3 of earth's gravity, when the water is exposed to a magnetic field of 8T and 50T/m [1].

2. The Effect of Magnetic Fields on Fibrinolytic Processes. Fibrin dissolution was observed and fibrinolytic activities were evaluated using a fibrin plate method. Mean levels of fibrin degradation products were higher when exposed to 8T magnetic fields. This phenomena is explained by the Moses Effect of the plasmin solution which penetrates well into fibrin gel.

3. Effect of Magnetic Fields on Combustion and Gas Flow. In examining oxygen dynamics in air we observed that flow patterns of gases are influenced by magnetic fields. Candle flames are pressed down and can be extinguished by magnetic fields. A model called the "magnetic curtain" has been introduced to explain this phenomena. The magnetic curtain is an invisible barrier which is produced in air by the interaction between magnetic fields and paramagnetic oxygen molecules. The interception of oxygen by the magnetic curtain extinguishes flames.

4. Redistribution of Dissolved Oxygen Concentration. The spatial distribution of oxygen concentration dissolved in water was measured by a dissolved oxygen meter. A clear redistribution of oxygen concentration was observed, and the dissolved oxygen concentration increased more then 10% around the center of the magnet [2].

5. Effect of Magnetic Fields on Peripheral Blood Circulation and Skin Temperature *In Vivo*. We studied the effect of 8T static magnetic fields on the peripheral blood flow, blood pressure, heart rate, and body temperature of an anesthetized rat. Blood flow decreased by 10% during magnetic field exposure. Blood pressure, heart rate and subcutaneous temperature continuously decreased during magnetic field exposure and recovered after removal from the magnetic field. Skin temperature decreases may be attributable to the accelerated evaporation of water from the skin by magnetic fields.

6. Embryonic Development of Frogs Under Intense Magnetic Fields. We studied the possible influence of intense magnetic fields up to 14T on the early embryonic development of *Xenopus laevis*. No apparent teratogenic effects were observed when the embryos were cultured under magnetic fields up to 14T for 20 hours from the stage of uncleaved fertilized eggs to the neurula stage.

7. Biochemical Reactions Catalyzed by Catalase, Xanthine Oxidase, and Other Enzymes Under Intense Magnetic Fields. We studied whether magnetic fields of up to 14T affect the activity of several enzymes. We observed no effect on the reaction of superoxide-dismutase, peroxidase, and xanthine oxidase. However, we observed changes in the absorbance of the reaction mixture of hydrogen peroxide and catalase during and after magnetic field exposures. The results indicate that magnetic fields affect the dynamic movement of oxygen bubbles that are produced in the reaction mixture by the decomposition of hydrogen peroxide, but not the catalytic activity of the catalase itself [3].

References

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