

Ultrastructural and functional changes of *Azotobacter vinelandii* as a consequence of shielded magnetic environment

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In order to survey how magnetic fields affect the life span and the nitrogenase (an iron-sulphur enzyme) activity of *Azotobacter vinelandii*, the biological tests were incubated under shielded magnetic field and also in normal geo-magnetic environment. The shielding level was about 10^{-6} of the terrestrial magnetic field. Our researches suggest that the main point in biological structures, which seems to be affected by the low magnetic environment, is the water molecule. As compared to control, the life span of microorganisms was shorter in shielded environment. Shielded magnetic environment induces different reactions depending on the time of exposure. The cells under normal geo-magnetic field showed higher nitrogenase activity than cells exposed to low magnetic fields. Many changes affecting the internal membranous network occurred under experimental conditions.

The mechanism involved in the effect of very low magnetic fields upon life is unclear. A major effect of magnetic shielded environments upon biological structures is significant loss of water (Dobrota et al., 2004). In solution, the degree of molecular alignment with the static magnetic field is proportional to the product of the anisotropy of the molecular magnetic susceptibility and the square of the magnetic field strength. Unstructured water having fewer hydrogen bonds is a more reactive environment (Ottiger, 1997). This may be related to the observed effects of very low magnetic fields upon life upon the biochemistry, physiology and ultrastructure of living cells.

Another mechanism may be related to the fact that many molecules (especially those associated with cell membranes) show anisotropy and thus they are oriented in magnetic fields. Consequently, their reactivity being anisotropic this allows them to interact with an oscillatory driving force and result in locally nongentropic effects, such as transducing energy from an electrical form to a chemical form. A membrane transporter may convert electrical energy from an oscillating membrane potential to chemical energy of the transported substrate. This ability requires only that the transporter exhibits unequal affinities for a ligand on the two sides of the membrane, and that the membrane protein can respond to a periodic potential, e.g. an oscillating electric field (Zrimec et al., 1998). A very low magnetic field may be affecting this delicate balance and impair the energetic activity of living cells.

References

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