

Influence of extremely low frequency electromagnetic field on antioxidant system and change of volatile composites in *Pinus sylvestris* L.

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Summary. The present study investigated the effect of extremely low frequency electromagnetic fields (ELF - EMFs) from high voltage power line on the antioxidant balance and inducible volatile emissions of *Pinus sylvestris* L. needles. The samples were collected from pines just below power line (P0, 50.66 mG) and 10 meter away from same power line. They were then categorized as P0 (just below power line) and 10 meter away from the same power line (P10, 6.30 mG). ELF - EMFs inhibited superoxide dismutase (SOD), catalase (CAT), and peroxidase (POX), but increased hydrogen peroxide (H₂O₂) and malondialdehyde (MDA) contents in needles of P0 plants. Therefore, volatile components of needles were investigated by GC-MS. The total rate of the volatile components for P0 and P10 plants was determined as 93.39% and 95.11%, respectively. α -pinene (20.74%), cyclohexene (9.20%), caryophyllene (9.10%) and bornylacetate (8.13%) were identified as main components in needles of P0 plants, and α -pinene (17.40%), bornylacetate (17.33%), cyclohexene (14.98%) and β -pinene (13.24%) in needles of P10 plants. Consequently, our findings suggest that Pine trees are sensitive to ELF - EMFs emitted from power line due to cause oxidative damage and alter the rate of volatile components in pine.

Key words: pine, reactive oxygen species, essential oil, power line, HS-SPME-GC-MS

Introduction

All live in the world in world have expressed concern that exposure to Electromagnetic fields (EMF) from mobile phone base stations and high voltage power lines may have adverse effects on their health. The biological or biochemical consequences of electromagnetic fields are entirely dependent on the frequency range and the intensity of the applied field. Extremely low frequency fields exist wherever a time-varying voltage, for example mains electricity at 50 Hz, is present, regardless of whether or not any current is flowing. The extremely low frequency field's sources are both external, such as power lines and transformer stations, and internal, such as the home electrical system, appliances and electrical equipment connected to the electrical network (1-3).

Plant productivity is minimized by the number of factors such as soil salinity, droughts, and soil erosion and widespread of disease. Electromagnetic field resulting from extremely low frequency fields (ELF - EMFs) is one of this adverse situation in the earth. Whole organisms including plants are interacted with magnetic field in day to day life. Generally, the earth acts as a magnet with their south and north poles and the natural effects of magnetic field have been changing the plant growth and yield in the globe. However, very limited studies have been conducted in biology to describe the role of ELF - EMFs (4). One possible explanation for the adverse effects of ELF - EMFs on living organisms is oxidative stress by an increase in the production of reactive oxygen species (ROS) (5,6). Oxidative stress affects the membrane structure and cell growth and can even cause cell death (7). This in turn triggers a cas-

