

Enhancing of Antibacterial Activity of Essential Oil by Rotating Magnetic Field

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Abstract : Essential oils (EOs) are fragrant volatile oils obtained from plants. These are used for cooking (for flavor and aroma), cleaning, beauty (e.g., rosemary essential oil is used to promote hair growth), health (e.g. thyme essential oil cures arthritis, normalizes blood pressure, reduces stress on the heart, cures chest infection and cough) and in the food industry as preservatives and antioxidants. Rosemary and thyme essential oils are considered the most eminent herbs based on their history and medicinal properties. They possess a wide range of activity against different types of bacteria and fungi compared with the other oils in both in vitro and in vivo studies. However, traditional uses of EOs are limited due to rosemary and thyme oils in high concentrations can be toxic. In light of the accessible data, the following hypothesis was put forward: Low frequency rotating magnetic field (RMF) increases the antimicrobial potential of EOs. The aim of this work was to investigate the antimicrobial activity of commercial *Salvia Rosmarinus* L. and *Thymus vulgaris* L. essential oil from Polish company Avicenna-Oil under Rotating Magnetic Field (RMF) at $f = 25$ Hz. The self-constructed reactor (MAP) was applied for this study. The chemical composition of oils was determined by gas chromatography coupled with mass spectrometry (GC-MS). Model bacteria *Escherichia coli* K12 (ATCC 25922) was used. Minimum inhibitory concentrations (MIC) against *E. coli* were determined for the essential oils. Tested oils in very small concentrations were prepared (from 1 to 3 drops of essential oils per 3 mL working suspensions). From the results of disc diffusion assay and MIC tests, it can be concluded that thyme oil had the highest antibacterial activity against *E. coli*. Moreover, the study indicates the exposition to the RMF, as compared to the unexposed controls causing an increase in the efficacy of antibacterial properties of tested oils. The extended radiation exposure to RMF at the frequency $f = 25$ Hz beyond 160 minutes resulted in a significant increase in antibacterial potential against *E. coli*. Bacteria were killed within 40 minutes in thyme oil in lower tested concentration (1 drop of essential oils per 3 mL working suspension). Rapid decrease (>3 log) of bacteria number was observed with rosemary oil within 100 minutes (in concentration 3 drops of essential oils per 3 mL working suspension). Thus, a method for improving the antimicrobial performance of essential oil in low concentrations was developed. However, it still remains to be investigated how bacteria get killed by the EOs treated by an electromagnetic field. The possible mechanisms relies on alteration in the permeability of ionic channels in ionic channels in the bacterial cell walls that transport in the cells was proposed. For further studies, it is proposed to examine other types of essential oils and other antibiotic-resistant bacteria (ARB), which are causing a serious concern throughout the world.

Keywords : rotating magnetic field, rosemary, thyme, essential oils, *Escherichia coli*

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