CONTROL OF BIOPHYSICAL AND STRUCTURAL PROPERTIES OF MICROORGANISMS BY ELECTROMAGNETIC WAVES

A Thesis

Presented to the Graduate School
Faculty of Science, Alexandria University
In Partial fulfillment of the
Requirements for the Degree

Of

Doctor of Philosophy of Science

In

Physics

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M.Sc. in physics (2008)

2013

SUMMARY

Bacteria are becoming increasingly resistant to almost all presently available antibiotics and this aspect is becoming a worldwide problem of highest significance. *Pseudomonas aeruginosa* is a common bacterium that can cause disease in animals, including humans. It is found in soil, water, skin flora, and most man-made environments throughout the world. It thrives not only in normal atmospheres, but also in hypoxic atmospheres, and has, thus, colonized many natural and artificial environments. If such colonization in critical body organs occurred, such as the lungs, the urinary tract, and kidneys, the results can be fatal.

The potential use of alternative means as an aid to avoid the wide use of antibiotics against bacteria pathogen has been recently arisen remarkably. The surge of interest has been marked by increasing efforts in research to explore the possibility of controlling the activity of bacteria and its sensitivity to antibiotics by using extremely low frequency electromagnetic fields. The frequency response of several biological systems suggest that electromagnetic fields require repetition and are most effective at frequencies that coincide with natural rhythms of the processes affected.

This work is devoted to find the frequencies of amplitude modulated waves, pulsed magnetic fields and pulsed electric fields that cause maximum changes in the growth of *Pseudomonas aeruginosa* (ATCC 27853) in the range 0.1-50 Hz and the most effective exposure time. The effects of exposure to all facilities on biophysical and cellular structure and genetic alterations of the microorganism were studied. Furthermore, uncontaminated and contaminated injured animals by *Pseudomonas aeruginosa* were exposed to pulsed electric fields to find out the feasibility of applying such new methodology in vivo.

Results indicated that exposure to amplitude modulated waves, pulsed magnetic fields and pulsed electric fields can inhibit the growth of the bacteria at particular resonance frequencies 0.5 Hz and 0.7 Hz with pronounced lethal effect of exposure to PMF alone. The Electrophoretic amplified DNA pattern of exposed *Pseudomonas aeruginosa* samples indicated genetic changes attributed to exposure to pulsed magnetic fields and pulsed electric fields. The results also depicted increase in antibiotic susceptibility of exposed cells to protein and cell wall inhibitors and this is clearly observed from the transmission electron microscope (TEM) images which showed a significant cell wall deteriorations and low density intracellular biomaterial. The structural alterations were supported by the data obtained form the dielectric measurements which indicated pronounced decrease in the dielectric loss, relaxation time and conductivity for the exposed samples compared with the control ones. Moreover, the in vivo results indicated wound healing development and increase in the wound size contraction of treated animals in compare with untreated ones.

It was concluded from the results that, this technique is a new un-thermal promising technique as an aid to avoid the use of antibiotics against bacterial pathogen and also it is a non destructive, non expensive, safe and fast technique. These findings are interesting and promising for further research work for using the treated microorganisms in the production of vaccines. The in vivo results indicated the feasibility of applying and using of such new treatment technique against pathogens specially for whole body exposure in large organs infection.