

EFFECTS OF EXPOSURE TO MOBILE PHONE
INDUCED-ELECTROMAGNETIC FIELD ON
STAPHYLOCOCCUS AUREUS

MOHD SAUFEE AL FIRDAUS
MOHD ISMAIL

MBBS with ADVANCE MEDICAL SCIENCES
UNIVERSITI TEKNOLOGI MARA

2011

ABSTRACT

EFFECTS OF MOBILE PHONE INDUCED ELECTROMAGNETIC FIELD ON *STAPHYLOCOCCUS AUREUS*

Mohd Saufee Al Firdaus Mohd Ismail

Institute of Medical Molecular Biotechnology, Universiti Teknologi MARA

Advance Medical Science Dissertation, 2011

Effects of electromagnetic (EMF) field on microorganisms related to human had caught many attentions in line with the development and usage of new technology worldwide. The closest EMF inducer to human nowadays appeared to be mobile phones. *Staphylococcus aureus* (SA) had been reported as both a major culprit of diseases and a natural protective barrier (in the ear) to human. To date, knowledge on phenotypical changes of *S. aureus* exposed to EMF has not been documented in detail. The aim of this study was to investigate the effects imposed by EMF of a mobile phone on the phenotypic characteristics of *S. aureus*. Two conditions of radiation, standby-mode and on-call mode, at four different durations, 15, 30, 45 and 60 minutes, were executed. The effects of these conditions on the radiated *S. aureus* were evaluated based on comparisons made with the non-radiated *S. aureus*. The radiated *S. aureus* was studied on the viability and changes in growth pattern; morphology differences; biochemical reactivity level; the deviation of antimicrobial sensitivity and biofilm production in comparison to non-radiated strains. The viability study had shown that growth of *S. aureus* was enhanced under the standby condition while the on-call condition, growth was suppressed. These two outcomes were influenced by the differences in the strength and duration of exposure of the EMF. No change in the growth curve pattern was observed for the irradiated *S. aureus*. The morphology of the *S. aureus* when viewed under direct light and scanning electron microscopes had showed that the shape and arrangement of the organism was highly preserved. The biochemical properties and antimicrobial sensitivity of *S. aureus* was not affected while the quantification of biofilm had shown a slight deviation in the glycocalyx production compared to normal. It is postulated that the complexity of the cell wall is one of the major contributors to the compensatory mechanism of adaption of the survived cells. These finding could in the future be used as a starting platform in research and development of other electromagnetic effects on the human related microorganisms.

AKNOWLEDGEMENTS

I would like to express my highest gratitude to AP Dr. Zaini Mohd Zain who has given me tremendous supervision and guidance, her undivided attention and support, and for her kind heart which had made my life in Advance Medical Science (AMS) programme something unforgettable. I would also like to thank AP Ir Dr. Norlida Buniyamin from the Faculty of Electrical Engineering for her comments and ideas on the setup of the project. I also wish to thank Dr. Gabriele Ruth Anisah Froemming, Director of Institute of Medical Molecular Biotechnology (IMMB) for her permission to access all the equipments and consumables required for this study.

Many thanks to Prof. Dr Mohammed Nasimul Islam for all the efforts he put to make this AMS programme beneficial. Special thanks to Mr. Tuan Muhd Hafidz Tuan Kamauzaman and Mrs. Norita Salim for their assistance in the work involving scanning electron microscopy. My appreciations also go to Mrs. Marina Mohamed, Mrs. Norzilawati Mohamad Isa, Mr. Muhamad Syafiq Rosman, Mr. Mohd Faez Sarulan and Mr. Yusri Idorus. for their technical support throughout this programme. I do not forget to thank all the Microbiology Diagnostic staff of the Centre for Pathology and Diagnostic Research Laboratory of Sg. Buloh 2010/2011 for all their help in detecting and solving errors during the experiment. I would also like to offer my gratitude to staff of the Multidisciplinary Laboratory on level 7, UiTM Shah Alam, for their willingness to spare consumables and bacteria culture for this study. Also, my appreciations go to all postgraduate students and IMMB staff who may have involved in this project directly or indirectly.

It is a customary for me to acknowledge the Faculty of Medicine, UiTM for granting me the one-year study leave from the original Medical Programme and the opportunity to embark into the AMS programme. I must also thank Department of Public Services Malaysia, for the financial support and their willingness to extend my scholarship for this programme. A lot of thanks to my parents _____ and _____, for their patient and readiness to share the hardship with me doing the AMS programme and to my family members, for their understanding of my situation as a student.

CONTENTS

ABSTRACT	2
ACKNOWLEDGEMENT	3
Note of Declaration	4
CONTENT	5
LIST OF ABBREVIATIONS	13
CHAPTER ONE	15
<i>STAPHYLOCOCCUS AUREUS</i> AND ELECTROMAGNETIC FIELD	15
1. Introduction	15
1.1. <i>Staphylococcus aureus</i> and other Residential Organisms	15
1.2. Interaction between Normal flora and the Host	16
1.3. Characteristic of <i>Staphylococcus aureus</i>	17
1.4. EMF and its usage: Beneficial or Detrimental?	17
1.5. EMF and Bacteria: Gene Insertion	18
1.6. EMF and Bacteria: Bioluminescence	18
1.7. EMF and Bacteria: Growth Rate and Viability Study	18

CHAPTER ONE

STAPHYLOCOCCUS AUREUS AND ELECTROMAGNETIC FIELD

1. Introduction

1.1. *Staphylococcus aureus* and other Residential Organisms

Staphylococcus aureus (*S. aureus*) is one of the indigenous bacteria found in the outer ear (or auditory) canal (OEC) of a normal, healthy human being. The bacteria were usually found together with other species such *Staphylococcus epidermidis*, *Staphylococcus albus*, *Corynebacterium* spp. and *Streptococcus viridians* (Wang *et al.* 2005). Organisms other than bacteria, such as fungi can also be found in the OEC. All together, these organisms are known as the residential flora of the OEC (Mahon *et al.*, 2007). These organisms play a very big role in human ear. Based on many studies, the organisms were known as symbionts and lived in symbiosis with the host. Symbiosis is a relationship where both the host and the organism gain benefit from each other. This relationship can also be described as mutualism. The organism protects the host's ear canal from being colonized by pathogenic organism while at the same time the organism thrives from the nutrients supplied by the host. The role that the bacteria played can be compared with those organisms living in the mouth, intestine and vagina of a healthy human though the species of the residential flora of those niches differ (Mahon *et al.*, 2007).