Ain Shams University
Faculty of Pharmacy
Microbiology & Immunology dept.

"DETECTION, HARACTERIZATION, AND INACTIVATION OF QUORUM SENSING SYSTEM IN SOME GRAM-NEGATIVE BACTERIA"

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

MASTER DEGREE

IN

PHARMACEUTICAL SCIENCES

(MICROBIOLOGY & IMMUNOLOGY)

BY

SARRA EBRAHIM SALEH MOHAMMED

BACHELOR OF PHARMACEUTICAL SCIENCES, FACULTY OF PHARMACY, AIN SHAMS UNIVERSITY, 2001

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Sarra Ebrahim Saleh

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INTRODUCTION

Bacteria communicate with one another using chemical signaling molecules as words. Specifically, they release, detect, and respond to the accumulation of these molecules, which are called autoinducers. Detection of autoinducers allows bacteria to distinguish between low and high cell population density, and to control gene expression in response to changes in cell number. This process, termed quorum sensing, allows a population of bacteria to coordinately control the gene expression of the entire community. Quorum sensing confuses the distinction between prokaryotes and eukaryotes because it allows bacteria to behave as multicellular organisms, and to reap benefits that would be unattainable to them as individuals. Many bacterial behaviors are regulated by quorum sensing, including symbiosis, virulence, antibiotic production, and biofilm formation. Recent studies show that highly specific as well as universal quorum sensing languages exist which enable bacteria to communicate within and between species. Finally, both prokaryotic and eukaryotic mechanisms that interfere with bacterial quorum sensing have evolved. Specifically, the secretion of enzymes that destroy the autoinducers, and the production of autoinducer antagonists, are used by competitor bacteria and susceptible eukaryotic hosts to render quorum sensing bacteria mute and deaf, respectively (Schauder and Bassler, 2001).

The present study aimed to investigate quorum sensing phenomenon in some Gram negative clinical isolates. This study is concerned with detection of such phenomenon using an indicator bacteria (a biosensor) and studying some

physiological functions of the collected isolates. The inactivation of quorum sensing signals was also attempted.

Aim of the work:

The study was accomplished through the following objectives:

1. Isolation and identification of some Gram negative bacteria from clinical specimens.
2. Detection of bacteria having quorum sensing system among the isolates using a biosensor.
3. Studying some physiological functions and behaviors of isolates that showed quorum sensing mechanisms, such as biofilm formation, enzyme and pigment production.
4. Inactivation of quorum sensing system/s of some selected isolates by other bacterial species was attempted.

LITERATURE REVIEW

1. Quorum sensing-wide spread bacterial communication system

For many years, researchers thought of bacteria as individual cells created to proliferate under various conditions but unable to interact with each other and to collectively respond to environmental stimuli, as it is typical for multicellular organisms. This view began to change few decades ago (Juhas *et al.*, 2005). Advances in the study of bacterial gene expression have discovered that many bacteria employ a dedicated inter-cellular communication system. This bacterial decision-making system enables a given species to sense, integrate and process information from its surroundings, communicate with each other, and monitor its own population density and, as a response, activate or repress specific gene expression. This bacterial cell-density-dependent communication system is known as quorum sensing (Fuqua *et al.*, 1994).

To sense the surrounding bacterial population density, the bacterial quorum sensing system relies on one or more small signal molecules (also called "autoinducers"), which are produced and released by bacteria. In Gram-negative bacteria, the most commonly utilized and intensively investigated autoinducers are N-acyl-homoserine lactones (AHLs) **(Figure 1).** The acyl side-chain length and the substitutions on the side chain provide signal specificity (Eberhard *et al.*, 1981; Fuqua *et al.*, 1996)