Exploring antimicrobial agents from aquatic microbial ecosystem: a comparative study

Study by: Ruaa Raad Al-Alwany
Supervisor: Dr. Mohammad Al-Najjar

ABSTRACT

The use of natural resources as alternative sources for medical purposes significantly increases during the last decade. This rise in the use of natural resources helped overcome many medical problems, such as antimicrobial resistance, which is the cause of increasing the rate of mortality, morbidity and financial burdens on patients and health insurances. One of the natural resources is the aquatic ecosystem, include marine and freshwater ecosystems. Both ecosystems, especially the microbial mats, are characterized by high biodiversity, productivity, and stability. They constitute enormous types of secondary metabolites which possess different physiological activities. For example, they can serve as antimicrobial agents against bacteria, fungi, amoeba, plants and insects. This study investigates and compares the antimicrobial activities of the microbial community composition of two aquatic microbial mats: the Tigris River (located in Iraq) and the Dead Sea (located in Jordan), against four types of pathogenic bacteria (*Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa*, and *Escherichia coli*) and one type of fungi (*Candida albicans*). The characterization of the two microbial mats ecosystems of the Tigris layers (upper, middle, lower and vertical layers) and Dead Sea vertical layer were done by 16s rRNA sequencing and highlighting the differences between the Tigris layers themselves and between the vertical layers for each aquatic ecosystem. The crude extractions from the different layers of the two mats were collected using water extraction and chemical solvents (Ethanol, ethyl acetate, and chloroform). Then we linked the resulted antimicrobial activities with their microbial community. The results from this study indicated that the Tigris vertical layer more diverse than the Dead Sea vertical layer, while the Middle layer of Tigris microbial mat more diverse than the upper and lower layers. Tigris vertical layer aqueous extract showed potential antibacterial activities against *S.aureus* and *P.aeruginosa* with MIC values equal or less than 0.39 µg\ µl and antifungal activity against *C.albicans* with MIC value equal 12.5 µg\ µl. In addition, the upper and middle layers of the Tigris microbial mat showed less antibacterial activities; however, the lower layer did not show any activity. At the same time, the Dead Sea microbial mat showed antibacterial activities for the four tested pathogenic bacterial strains, with a MIC value of 50 µg\µl. In summary, Tigris microbial mat possessed more antibacterial and antifungal activities than the Dead Sea microbial mat. When considering the Tigris mat, both the upper and middle layers demonstrated antibacterial effects; on the other hand, the lower layer had no antibacterial effects.