

# **Evaluation of the Antibacterial, Antibiofilm and Anti-Virulence Activities of some Jordanian Honeys with Manuka Honey: A Comparative Study**

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## **Abstract**

In recent years, due to the spread of antibiotics resistance; the need for alternatives has increased and the attention turned to study the efficiency of natural products -including honey- as potential alternative and complement treatments. This study examined the antibacterial and antibiofilm activities for selected types of Jordanian honeys (Shawkiat honey and Rabiee honey) with type of New Zealand honey (Manuka honey) and their effect on the Gene Expression Profile of selected strains of bacteria; *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* (*S. aureus*). The antibacterial activity was investigated by agar well diffusion assay, Minimum Inhibitory Concentration (MIC), Minimum Bactericidal Concentration (MBC), growth curve and time-kill curve assays. While the antibiofilm activity were examined using biofilm inhibition assay and biofilm degradation assay. As well as the effect on the gene

expression profile was analyzed using Real Time quantitative Polymerase Chain Reaction (RT-qPCR). Agar well diffusion assay demonstrated that 25% concentration of tested honeys was able to produce inhibition zones against *E. coli* and *S. aureus*. MIC values of Shawkiat, Rabiee and Manuka honeys were 25%, 25% and 20% and MBC values were 50%, 50% and 25% respectively against both strains. The growth kinetic curve was affected; as the optical density, lag phase and exponential phase for both strains were decreased in time-dependent manner and the growth was inhibited after 24-hour incubation with all tested honeys compared to untreated samples. Time kill curve assay demonstrated that both bacteria lost viability and couldn't recover after 24-hour. The lowest concentration was able to inhibit and eradicate the biofilm of *E. coli* and *S. aureus* was 20% of all tested honeys. RT-qPCR assay showed that after treatment with tested honeys all selected genes were downregulated in the range 3.3-fold to 6.2-fold of *E. coli* genes and 3.1-fold to 6.1-fold of *S. aureus* genes. The results of this study indicate that the Jordanian honeys possess antibacterial, antibiofilm and anti-virulence activities.

**Keywords:** Antibiofilm, Jordanian honey, Manuka honey, *Staphylococcus aureus*, *Escherichia coli*, Gene expression profile.