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A strong inhibitory effect of heather honey, propolis and medicinal plant extracts on biofilm formation by pathogenic bacteria

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Introduction: *P. aeruginosa* and *S. aureus* are opportunistic pathogens that cause a wide range of infections. Their increasing resistance to antibiotics is a serious concern and making them susceptible to treatments is now more essential than ever. There is a need to discover new biofilm inhibitors to increase the susceptibility of these bacteria to antibiotics. 

Hypothesis and aims: To evaluate the antibiofilm activity of heather honey, propolis and medicinal plant extracts against *P. aeruginosa* and *S. aureus*.

Methodology: Determination of optimum biofilm growth was carried out using a time-course assay over 24 h intervals, using *P. aeruginosa* PA14 and *S. aureus* NCTC 4135 strains. The inhibitory effects of all extracts were determined by biofilm inhibition assay in 24-well plates, with biofilms stained with crystal violet and de-stained with ethanol:acetone; OD were measured at 550 nm. Planktonic growth was measured at 600 nm and samples from the wells were streaked to determine bactericidal effects.

Results: Heather honey extracts inhibited both *P. aeruginosa* and *S. aureus* by 68%. At 60 µg/mL, one of the propolis extracts promoted biofilm growth of both pathogens. Two other propolis extracts also promoted growth in *P. aeruginosa* but inhibited biofilm formation in *S. aureus* by 76.5% and 13.8%, respectively. Three plant extracts inhibited *S. aureus* biofilm by 7.5%, 10.2% and 87.6% and inhibited *P. aeruginosa* by -34.9%, 34.7% and 19.4%, respectively.

Conclusion: All samples showed varying biofilm inhibition capabilities, but biofilm formation seemed to be more easily inhibited in *S. aureus* than in *P. aeruginosa*.

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