RESEARCH GROUP: Pharmacy

Project Title: Antimicrobial activity of biosurfactants alone and in combination with antibiotics

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Level: PhD

Background to the project: During the last 10 years our group has been working on the characterisation and production of microbial biosurfactants with the major priority of investigating their potential applications in a range of commercial products. As part of this research we have investigated the effect of microbial biosurfactants on other microorganisms and it has become clear that significant antimicrobial effects can be observed against certain microorganisms, some of which have clinical significance. Although we have observed bacteriostatic and bacteriocidal effects the mode of action has not been investigated. In this project the antibacterial activity of selected low molecular weight glycolipid biosurfactants will be investigated and quantified together with an investigation of the direct effects of the biosurfactants on the metabolism of the bacterial cells themselves. Since these glycolipid biosurfactants have hydrophilic and hydrophobic moieties it is possible that their effects are limited to disruption of the integrity of the bacterial cell membranes leading to leakage of metabolites, however this has yet to be established. They may also affect other parts of the cell metabolism either through specific inhibition of pathways or the uptake of nutrients. An additional aspect of this project will be to examine the interaction of microbial biosurfactants with existing antibiotics particularly the polymyxin antibiotics which act on microbial cell membranes. Although polymyxins remain effective antibiotics against many bacteria they have severe side effects which limit their clinical use. If the combined use of polymyxin and biosurfactant could lower the effective dose for the polymyxin this would be an important contribution to sustain their clinical use.

Hypothesis: Glycolipid biosurfactants can be used as effective antimicrobial agents either alone or in combination with existing antibiotics.

Objectives of the research project:

The first objective of this project will be to investigate the effect of selected low molecular weight glycolipid biosurfactants on the growth and viability of a number of clinically important bacteria.

Second comparisons will be made between the effectiveness of the different biosurfactants in order to try and identify the characteristics of the biosurfactant which are antibacterial.

Mass spectrometry will be used to examine the effects of the biosurfactants on the metabolome of the treated bacteria and on the materials leaking from the damaged cells. These experiments will be used to identify the possible mode of action of the biosurfactants on sensitive organisms and to understand the reasons for resistance of others.

The effect of combining biosurfactants with polymyxins will be established with the aim of determining whether biosurfactants can be used to reduce the effective dose of polymyxins against sensitive bacteria.
Methods to be used: The methods to be used in this project include microbial propagation in batch flask and fermentation conditions, extraction and purification of microbial products using solvent extraction and other purification methods.

Selective staining methods will be used to observe the antimicrobial effects together with viable counting methods.

Mass spectrometry of fractions of the cells and leaked materials from the cells will be used to describe the effects of the biosurfactants on the metabolism of the cells under various conditions. HPLC and other analytical techniques will be used as required.

Skills required of applicant: BSc (Hons) and/or MSc in biological sciences, molecular biology or microbiology. Highly motivated, hardworking well organised individual who can work both independently and as part of a research team. Experience in one or more of; basic microbiological techniques, bioinformatics and HPLC-LCMS techniques will be an advantage but training will be provided.

References:


