Background to the project: Our group is working to maximise or optimize the production of biosurfactants in selected marine micro-organisms. Biosurfactants are produced extracellularly by microorganisms which efficiently reduce surface and interfacial tension of liquids (1,2). Due to these properties, biosurfactants have potential applications in diverse areas including, bioremediation, biomedical, pharmaceutical, food and chemical industries (3,4). The most commonly reported, low molecular weight glycolipids consisting of carbohydrate and lipid components is synthesized by *Pseudomonas* species (5,6). Marine microorganisms are known to metabolically and physiologically adapted to survive in extreme habitats (7,8). Marine-derived biosurfactants show stable activity at extreme temperatures, pH and salinity (9,10). Although various marine γ-proteobacteria are recognized to secrete surface active (SAs) molecules, the production of glycolipids by marine microbes is not yet reported. We are interested to evaluate the mechanisms and conditions regulating the production of glycolipid biosurfactants by selected marine bacteria. It will be interesting to know how the culture conditions such as, carbon source, nitrogen source, C:N ratio, micronutrients as well as chemical and physical parameters (temperature, aeration and pH) influence the composition and yield of the biosurfactants in marine bacteria. The characterisation of glycolipid production in marine bacteria is necessary to analyse its potential as a biosurfactant producing organism of industrial interest.

Hypothesis: The production of novel glycolipids by marine bacteria may contribute to the suitable alternatives for the surfactant industry.

Objectives of the research project:

1. To determine the contribution of different carbon sources, sugars and lipids, to the synthesis of glycolipid biosurfactants produced by selected marine bacteria. The fed-batch experiment using the limitation of the carbon sources, nitrogen sources, sugar and lipids will be performed to determine their effect on glycolipid synthesis. The study will help us to maximise or optimize the production of glycolipids in marine bacteria.

2. To establish the time course of glycolipid biosynthesis during the growth cycle of the bacteria. Biosurfactants are secondary metabolites and studies report their production begins with the onset of the stationary phase. The influence of pH and temperature may affect the onset of biosurfactant production. We will establish a time course of glycolipid biosynthesis during the exponential growth phase by limiting at least one medium component (nitrogen or phosphorous) or by varying pH, growth temperature etc.

3. To fully characterise and quantify the biosurfactants produced under different culture conditions.
The microbial glycolipids will be isolated, purified and characterized for their structural information. The information from analysis will allow synthesis of glycolipids with diverse structural characteristic and optimization of production yields.

4. To describe the expression patterns for genes involved in biosurfactant synthesis during the growth cycle. There are very few studies investigating the biosurfactant biosynthesis pathways and genetic systems in marine bacteria. We will characterise genes involved in glycolipid production to analyse their potential as a biosurfactant producing micro-organisms for industrial value.

5. To describe the regulatory determinants for glycolipid synthesis. The complete genetic system regulating biosurfactant biosynthesis will be studied. The detailed knowledge of the genetics of glycolipid production in marine strains would help to construct metabolically engineered strains with desired product characteristics.

Methods to be used: The methods to be used in this project include microbial propagation in batch flask and fermentation conditions. Real-time PCR will be performed to analyse the expression of glycolipid biosynthesis genes. Bioinformatics, metabolic engineering and synthetic biology tools will be used to identify novel genes and develop new pathways in engineered strains. Extraction and purification of microbial products using column chromatography, solvent extraction and other purification methods. Characterisation of the glycolipids and their quantification will be performed using HPLC and GC-MS techniques.

Skills required of applicant: BSc (Hons) and/or MSc in biology, microbiology, molecular biology or a biomedical science related area. 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, molecular biology, tissue culture, cell biology will be an advantage but training will be provided.

References: