ASM Education Special Interest Group

Microbial biotechnology education from a regional development perspective

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Advances in the manipulation of microbial cell biology have revolutionised science and placed microbiology in the centre of a rapidly expanding field that has come to be known as biotechnology. Discoveries of microbial origin are now a major driving force behind biotechnology, biomedicine, public health and environment.

In the "Smart State" Queensland, these advancements have been strategically targeted as the region's economic base develops knowledge industries to replace traditional methods with cutting edge technologies. Microbially-mediated technologies are thus gaining importance for the production of biofuels and bioproducts, bioenvironmental management of natural sources, bioremediation, waste and wastewater management.

The University of the Sunshine Coast (USC) has recently been selected as the only Australian university for an OECD study due to its engagement with the regional community. Against this background, the programme of biotechnology established at the Faculty of Science, Health and Education includes microbial biotechnology education that enables students to provide critical and innovative solutions using microorganisms for the region's growing needs, for example biological control of pests and pathogens; environmentally-friendly waste treatment methods; biodiscovery of agri-biologicals and novel therapeutic compounds to be derived from Queensland's unique biodiversity.

The USC programme of biotechnology has strategic alliances with local councils, DPIs and South East Catchment (SEQ Pty Ltd) and also aligns itself with the State government's regional development targets such as the introduction of environmental biotechnologies for sustainable urban development alternatives in energy generation and water technologies. The programme staff and the members of regional alliances communicate regularly to highlight local biotechnology needs and future prospects to be incorporated into the programme's course structure.

As an example, the third year Applied Microbiology and Biotechnology course builds up on the fundamental training the students have received early in the programme in microbiology (general and medical), molecular biology, biochemistry, research methods and design. During this year, while learning fundamental aspects of applied science and biotechnology, students are also presented with regional examples in the lectures toward inquiry-based regionally-significant topic selection for seminars/posters. This build-up approach lasts between 8-10 weeks and matures into student presentations in the last weeks of the term.

The topic selection also involves channelling learning outcomes and encouraging regional youth to bring their own life experiences (e.g. farming or horticultural background) into the classroom to find innovative solutions to regional problems. Presentation tasks are also designed in a way to help students understand the stages and processes involved in the microbial metabolite production and link these functions with real-life operations such as metabolic functions involved in biofuel generation as well as alcoholic beverage production.

As part of the biotechnology programme-regional alliance, visits to local industries are organised well into the course, familiarising students with key processes used at the sites. The students then critically evaluate the application of microbial derived biotechnologies in the visited operations for their course assessment (e.g. waste water treatment operations involving microbial digestion of biosolids). Laboratory practicals are designed to increase analytical, communication and interpersonal skills and to train students to work effectively in teams, to be later translated into workplace environments of regional industries and government institutions. During the laboratory sessions they also learn to appreciate the value of prompt record keeping for applied biomedical and environmental science as well as for intellectual property reasons. The course work is assessed in terms of fundamental science (50%), project work (25%) and laboratory skills (25%).

Pursuit of international standards is also aimed as tasks (e.g. literature review) are designed with international biotechnology advances in mind as well as most recent developments (e.g. bacteriophage therapy) so that students link up with the University's Global Exchange Opportunities Programme and 'think globally but act locally' on their return.

The long-term aim of the Applied Microbiology and Biotechnology course is to develop professionals capable of biotechnology initiative in the region. At the completion of studies, skills gained facilitate graduate employment with local

bio-businesses. As the urban and regional changes require more biotechnology entrepreneurs to participate in the sustainable development, this is a way of ensuring the distribution of the biotechnological capacity produced at USC along the Sunshine Coast.

The biotechnology programme also encourages links with the business faculty to increase the understanding of the importance of entrepreneurial thinking in biotechnological innovations and the basics of bioproduct marketing. Additionally, the course incorporates regulatory issues relevant to biodiscovery in line with the State government's policy position and collection permits for the discoveries targeting State-legislated resources. The aim is to familiarise students with the government institutions involved in the chain of biodiscovery. It also expands to cover regulatory issues on the international level such as the Convention on Biological Diversity.

Successful examples of the programme's teaching/learning outcomes in regional job placement with local businesses and councils include students building up on their own regional experiences, for example biological control of strawberry infections, biological control of biting midge in plant biotechnology and the biopesticides divisions of the local DPIs.

In summary, this course is designed to incorporate international advancements in biotechnology, encouraging innovative and entrepreneurial thinking within the regional context. There has been favourable feedback from the regional biotechnology sector to the discipline-based activities of the course, supporting further student engagement in the programme.

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Lab report

'Chocolate mousse' on Sunshine Coast beaches

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When spilled at sea, crude oils normally break up and dissipate over time [1]. However, sea water droplets may become suspended in this crude oil and, when subjected to physical mixing promoted by turbulence on the sea surface, form a very viscous emulsion. This emulsified oil, which is more persistent than the original, is often referred to as 'chocolate mousse' because of its appearance [2].

The Sunshine Coast region of Queensland is one of the fastest growing regions of Australia. In parallel with this growth, more frequent environmental pollution is occurring due to increasing domestic and industrial effluent volumes as well as marine pollution from busy maritime activities [3, 4]. In addition, this sub-tropical region regularly receives summer storms and heavy rains which carry environmental pollutants (grease, oils, dust, leaves and rubbish) as well as run-off motor oils from highways constructed with deliberate slopes to prevent flooding.

The region has been experiencing unusual foaming events on the coastal line during the summer seasons over the past few years (Figure 1). Foam forming actinobacteria have been identified as a problem in activated sludge plants for several decades [5]; they are classified in the genera *Corynebacterium, Dietzia, Gordonia, Mycobacterium, Nocardia, Rhodococcus, Skermania, Tsukamurella* and *Williamsia* [6-8]. In line with these reported observations involvement of these genera with foam production in the regional coastline is being investigated.

Culture of foam samples collected along the coastal beaches onto selective agar [9] revealed the presence of such taxa at the University of the Sunshine Coast (USC). Selected species, when tested in the laboratory in simulated run-off motor oil and sterilised sea water, successfully recreated the foaming event. When raw sewage was added to the samples, the foaming event became even more intensified (Figures 2a and b).

16s rDNA sequencing results obtained from two foam-causing isolates revealed that the species belonged to the genus *Saccharothrix* (Figure 3) previously reported to be present in the Australian environment (e.g. *Saccharothrix australiensis* [10]). These organisms can easily spread into the sea environments via wind and coastal pounding with high waves, and survive at the oil-water interface.

Although species of this genus have not been reported as disease causing agents as yet, considering that some of the species of this genus were transferred into this taxon from the genus *Nocardia* [11], their association with the foams and associated

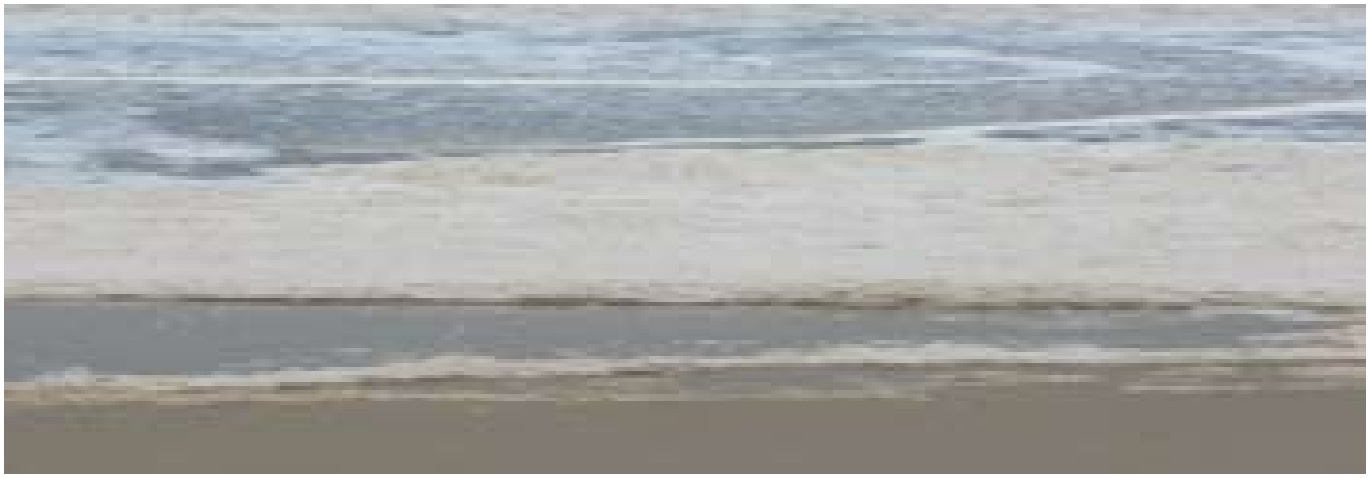

Figure 1. Example of the foam encountered on the beaches of the Sunshine Coast following storms and heavy rains in summer seasons.

bio-aerosols might require attention to determine whether they would constitute a public health risk to swimmers (Figure 4). Sequencing of the remaining isolates is underway in the USC laboratory and the outcomes will be communicated to the health authorities in the region.

(a) (b)

Figure 2. Foam created under laboratory conditions using sea water, the *Saccharothrix* isolate USC-10013 and (a) motor oil (b) motor oil+sewage.

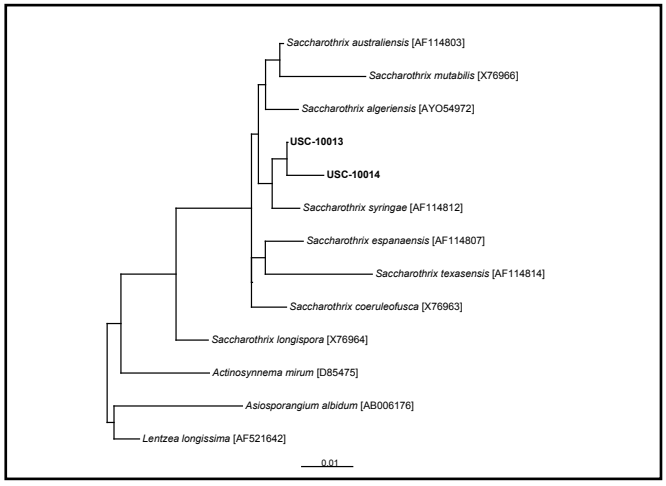

Figure 3. Phylogenetic tree of 16S rRNA gene sequences obtained from two of the foam isolates, compared against sequences obtained from public databases. The scale bar represents 1% sequence divergence. GenBank accession numbers of reference sequences are presented.

Figure 4. Local surfers covered with the foam.

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Contributions listing relevant meetings are welcome. Please send to: editor@theasm.com.au

14 May 2008
Food Science Australia, Brisbane, QLD
Food Microbiology Seminar Series:
Tales from the Green Book
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1-5 June 2008
Boston, MA, USA
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Web: www.asm.org

2-5 July 2008
Hilton on the Park, Melbourne, VIC
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Director: A/Prof Elizabeth M Dax / Workshop Secretariat: Linda Tracey
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Food Microbiology Seminar Series:
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For contact see 14 May above

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