

# Biodiscovery and industrial applications of microbial resources



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This issue of *Microbiology Australia* focuses on an aspect of microbiology increasingly becoming important to us microbiologists – the applied and industrial microbiology. The majority of microbiologists in the global context are in the business of dealing with the challenges that microorganisms bring to society involving processes and products that are of major economic, environmental and social importance. These include production of valuable microbial products via fermentation processes such as fermented foods, beverages and dairy products as well as direct application of microorganisms or their products in environmental and biotechnological operations. In addition, over the past 20 years, many traditional and established industrial fermentation processes have advanced through the contribution of genetic engineering, which has facilitated the development of many novel processes and products.

In the historical context, while performed for thousands of years, the scientific basis of traditional fermentation processes, as in the production of fermented dairy products and alcoholic beverages, was understood less than 150 years ago. In fact, when Pasteur demonstrated in 1857 that alcoholic fermentation in beer and wine production was a result of microbial activity rather than being a chemical process, he also launched industrial microbiology. The need for the antibiotic penicillin during World War II accelerated innovation in fermentation technology and the transition from small-scale culture to large-scale submerged fermentations, but more importantly accelerated media and microbial strain development. The knowledge gained has

been applied in many other fermentation industries. More recently, the ability to produce monoclonal antibodies for analytical, diagnostic, therapeutic and purification purposes has increased. Furthermore, genetic engineering and recombinant DNA technology have had a remarkable impact on traditional, established and novel fermentation processes and products. Many products formerly manufactured by chemical processes have come to be produced more economically by microbial fermentation and biotransformation.

Microorganisms are easier to mass cultivate, grow faster, and they allow the use of cheap substrates normally considered wastes as well as producing diverse industrially important products. Moreover, their readiness to undergo genetic manipulation has opened up endless possibilities for new products and services from fermentation industries.

While applied and industrial microbiology was rapidly advancing, biodiscovery as a side discipline was also providing fascinating new chemical structures derived from microbial metabolisms. Since the discovery of penicillin, actinomycin, streptothricin and streptomycin, the screening of microbial natural products still continues to present an important route to the discovery of novel chemicals for the development of new therapeutic agents. Furthermore, emerging new technologies, particularly functional genomics and bioinformatics coupled with advanced technologies, such as microarray technologies and proteomics, have enabled researchers to reveal the mechanism of action of

a compound, which, in turn, facilitated the establishment of the links between targets and compounds of interest with attractive properties.

'Megadiverse' Australia has a huge biodiscovery potential and it is in an advantageous position over other megadiverse countries. Such superiority stems from timely capitalising on its biodiversity and building a knowledge-based economy as well as encouraging research advancements, development infrastructure and capability.

The May 2010 issue of *Microbiology Australia* covers topics ranging from initial biodiscoveries to large-scale and commercial applications. Its timing coincides with a major international conference, the 11<sup>th</sup> International Symposium on the Genetics of Industrial Microorganisms (GIM2010) that is being held in Melbourne in June/July and indeed many of the contributors for this issue are members of the GIM2010 Local Organising Committee. This issue of *Microbiology Australia* will review some of the advances being made in the field of industrial microbiology through the power of genetics and molecular biological tools as well as biodiscovery of new and potent therapeutic agents from natural sources.

*In Focus* articles overview the field from discovery to commercialisation with the articles by Ipek Kurtböke, Ian Gust and Rodney Carbis. Some of the *Under the Microscope* articles feature snapshots of specific biodiscovery achievements and cover a range of microorganisms. Endophytes feature in the article by Kirsten Miller *et al.* providing an understanding of how their genetics may improve the applications of traditional medicines. Ipek Kurtböke shows how bacteriophages themselves can be used as tools in drug discovery programs.

Search and discovery in unusual environments and targeting different producer organisms and targets will also be covered. Tanya Sorrell *et al.* review how fungal phospholipid metabolism is driving antifungal drug discovery, while Paul Young reviews the development of new antivirals. Rob Capon takes us to marine biodiscovery and the chemical variety that is being offered by marine microorganisms. Ian Macreadie and co-workers provide information on the biodiscovery of chemo-preventatives from yeast to be exploited further to prevent Alzheimer's disease.

One of the oldest areas of industrial microbiology and biotechnology is food and beverage fermentations based on

microbial metabolic activities. Jennifer Bellon reviews how dissecting the genetics of the bacteria and yeast involved in wine production is adding value to Australia's wine industry.

A very topical issue of world importance is renewable energy. Grant Stanley and Geoff Dumsday review what has happened in the past and what the future offers with novel microbial processes designed to make second generation biofuels. The scale-up aspect is covered with an article by George Lovrecz *et al.* describing how Australia's NCRIS facilities are aiding large-scale industrial fermentation as well as downstream processing.

Queensland is one of the biodiverse states of Australia which has the highest rate of endemism which provides the state a competitive advantage over other states in biodiscovery programs. Queensland State Government's Office of Biotechnology, Therapeutic Medicines and Devices from the Department of Employment, Economic Development and Innovation provides an overview on the Queensland biodiscovery industry and *Biodiscovery Act*. Another overview on biodiscovery and biotechnology comes from the Victorian Government, representing the biotechnology capital of Australia.

Finally, this issue includes an 'Historical review', a tribute to Arnold Demain, who is regarded as a pioneer in the genetics of industrial microbiology. A particular achievement is Arnold's role in the production of the first hypercholesterolemia drug, Lovastatin at Merck. During the GIM2010 in Melbourne a plenary talk will be presented by Prof. Demain

GIM2010 will highlight the recent advances in the field of *Genetics of Industrial Microorganisms* and some of the GIM presenters will continue on (in the following week) to ASM's National Conference in Sydney to present their work to the wider group of microbiologists. The conference will bring key scientists working in the field from four corners of the world together in Melbourne, the 'Biotechnology Hub of Australia' and will provide opportunities for interactions between them and the Australian scientists.

We hope that this issue of *Microbiology Australia* will give its diverse readership a variety of snapshots under the conference theme, and a perspective that much good can be gained from the application of microbial biotechnologies.