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Editorial

Environmental Microbiology meets *Microbial Biotechnology*

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We would like to begin this editorial by paying a modest but sincere tribute to Professor Kenneth Timmis for his recent nomination as a member of the Royal Society of the United Kingdom. Kenneth Timmis has pioneered science fields related to plasmid replication, biodegradation, microbial ecology, biodiversity and most recently metagenomics. In addition, to these many relevant scientific contributions, his services to the scientific community have been of paramount importance at the level of training for new generations of scientists and promotion of excellence in science through his role in journal editorial. Initially, as Editor for the *Journal of Bacteriology* (1989–1997) and then with the creation of two journals; one, *Environmental Microbiology*, that 10 years after the first issue came to light is the fifth journal in the area of microbiology and probably the leading journal in the field of environmental microbiology; the other, *Microbial Biotechnology*, that reflects his vision of microbes as useful biotechnological tools. Although *Microbial Biotechnology* is in its early infancy it has already attracted the attention of a specialized audience. The title of this editorial also entertains the idea that the future of *Microbial Biotechnology* will not only be based on food, energy, pharmaceutical and clinical microbiology, but will bring into the equation the many relevant aspects of environmental microbiology which contribute to the diversity of processes biotechnology can offer to society.

An excellent example of *Environmental Microbiology* meeting *Microbial Biotechnology* comes from the publications by Kamilova and colleagues (2008) and Péchy-Tarr and colleagues (2008). These articles emphasize two very relevant features in environmental microbiology, namely, the identification of new genes that encode proteins with potential to control insect pests and the phytopathogen *Fusarium*. Biotechnological exploitation of biocontrol properties of microbes requires an in-depth knowledge of microbial genetics and physiology and/or the dissection in the lab of these properties, as well as specific training in designing and performance of field trials in which to test the microbes' new potential. Plant–microbe interactions constitute a fascinating field of interkingdom communication, some novel aspects of how bacteria sense plant signals and vice versa have been summarized by van Dillewijn (2008) in his highlight article entitled: what gets turned on in the rhizosphere?

The field of plant–microbe interactions is extremely important to biotechnology; for this reason *Microbial Biotechnology* will dedicate an entire special issue to this area, which is expected to be published mid-2009 with the assistance of invited guest editors with expertise in a number of fields (see announcing flyer).

A set of articles published in this first volume of *Microbial Biotechnology* have dealt with microbial biofuel production (Maeda et al., 2008; Vardar-Schara *et al*., 2008; Wackett, 2008a,b). The scientific community recognizes the potential of hydrogen as an alternative fuel due to its higher energy content than fossil fuels, its renewable nature, and because its product of oxidation is water. These advantages were already envisaged some 25 years ago (Takakuwa *et al*., 1983); however, not until recently have social demands for a cleaner environment led to a renewed interest in the theme. A relevant question regarding hydrogen production is its production limits. Limitations can arise from physical constraints – which could be solved via improvements in process development and/or fermentor design, or from the thermodynamic limits that govern reactions that lead to hydrogen production. In relation to this issue, Veit and colleagues (2008) explore the thermodynamic aspects limiting hydrogen yield in microbial fermentations; key reactions $NAD(P)H + H^+ \leftrightarrow NAD(P)^+ + H_2$ hypothetically achieve equilibrium at very low partial hydrogen pressure, and the authors probe this through the design and thermodynamic analysis of a synthetic $NAD(P)H:H_2$ pathway in *Escherichia coli* BL21 (DE3). The system consists of a ferredoxin-dependent hydrogenase, ferredoxin as electron acceptor/donor intermediate, and a NAD(P)H:ferredoxin oxidoreductase.

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Results revealed that in both cases these pathways are influenced by partial headspace hydrogen pressure under closed bath conditions and that the NADPH:H_2 system allows higher hydrogen accumulation than the NADH:H_2 pathway.

Novel molecules are the panacea for survival of large and small companies in the Biotech area. New methods that lead to more efficient synthesis of added value molecules are needed. This may involve the discovery of new molecules or the continuous improvement of a process through the identification of new enzymes. Both aspects are under consideration in this issue. Thiwthong and colleagues (2008) report on new aldehyde dehydrogenases for the synthesis of glyoxylic acid, an important compound in the pharmaceutical industry. They have purified and characterized two aldehyde oxidases, F10 and F13, from *Pseudomonas* sp. MX-058. Both catalyse the oxidation of glyoxal to glyoxilic acid, and their kinetic properties hold potential for being economically and industrially exploitable. The authors claim these novel enzymes overcame limitations found earlier with aldehyde dehydrogenases from different eukaryotes. A unique feature is that the

quaternary structure of the F13 enzyme revealed it to be heteropentameric.

Expression of heterologous genes for use in a number of biotechnological applications has been the subject of intense research over the last 20 years (for a review see Bertram and Hillen, 2008). In this issue Fisher and colleagues (2008) systematically examined the twin-arginine translocation system for secretion of heterologous proteins. The system is superior in yield and specific activity for secreted proteins than the 'classical' SEC pathway. One of the beauties of the system is that only properly folded proteins are exported to the periplasm; a screening process that guarantees correct protein properties.

Medical and pharmaceutical industries are searching new cell targets for drug discovery. Glutamate racemase, a member of the cofactor-independent, two thiol-based family of amino acid racemases, has been implicated in maintaining sufficient D-glutamate pool levels required for peptidoglycan cross-linking; which in turn is of critical importance for bacterial growth. Fisher (2008) reviews the history of this enzyme, the recent biochemical and structural characterization of several isoenzymes and how a set of new inhibitors have been found. This research is of upmost significance for the pharmaceutical sector because peptidoglycan synthesis has long been an important antimicrobial drug target. Continuing on the theme of biotechnological applications of medical importance is the article published by Barbuddhe and Chakraborty (2008). Here the authors give a comprehensive review of the current and potential uses for the human pathogen *Listeria monocytogenes* in biotechnology. Because *L. monocytogenes* is capable of subverting host cell function and is able to survive and replicate within numerous eukaryotic cells during the infection process, it is an attractive delivery vehicle for use in both clinical and biotechnological applications. In fact *Listeria* are already being used to facilitate heterologous antigen presentation on the surface of antigen presenting cells and the Listeriolysin O protein has been used to assist DNA delivery by cell transfection for use in cell biology studies. The authors also consider the potential use of *Listeria* in the development of novel vaccine and drug delivery systems by exploiting their sophisticated approach to infection. Undoubtedly, future research allowing the development of these so-called 'patho-biotechnology' approaches will be of great interest over the coming years.

Biosensors have also been the subject of mini-review in *Microbial Biotechnology*, and a model for internal calibration of biosensors was recently published (Wackwitz *et al*., 2008). In the current issue a type of cell-based biosensor is reported that permits one to distinguish pathogenic from non-pathogenic strains of *Bacillus cereus*, a technology that holds promise for detection of pathogenic bacteria in food (Hutchison *et al*., 2008). The whole-cell sensor system consists of erytrophore cells of *Betta splendeus*. The extension of the system to detect other pathogens is of major interest and of great importance in food biosafety.

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