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Editorial

New avenues for *Microbial Biotechnology*: the beginning of a golden era

Jean de Genève* and Matilde Fernández
Bio-Iliberis Research and Development, Parque Tecnológico de Ciencias de la Salud, Edificio BIC, Lab. 203. 18100 Armilla, Granada, Spain.

The first issue of *Microbial Biotechnology* has just seen the light and it was conceived with the aim of covering an important niche in the area of the potential exploitation of microorganisms in products of interest to human beings. No other journal has attempted to cover this area in depth, although humans have exploited microbes for hundreds of years to produce bread, wine, dairy products and more recently food preservatives, antibiotics, energy conversion systems etc. (Sánchez and Demain, 2008).

At present new advances in biodiversity, genomics, synthetic biology and the more recent metagenomics are opening new research opportunities on the physiology of microbes as single individual cells and consortia enabling us to begin to better understand the immense potential of 'niche-based' microorganisms for new applications. The impending exploitation of microorganisms for the synthesis of added-value products – including microbes, enzymes, proteins or products in a wide sense – will experience an outburst that will come not only from the field of microbiology, but also from other fields such as organic chemistry, bioelectrochemistry, physics and nanotechnology. The scientific community, both academic and industry-based, can only but welcome this new journal with open arms.

The first issue covers topics that range from gene regulation for the expression of proteins to the application of microorganisms to produce fuels or remove persistent pollutants. All of these areas, together with the explanation of new tools to produce CpG-methylated plasmid DNA (Fletcher, 2008), will open our minds to the fabulous world of microbial technology.

The opening article is a review by Bertram and Hillen (2008) that deals with the use of the TetR repressor as a means to control heterologous gene expression. The review is very timely as TetR is a repressor that recognizes its target operator with high affinity (Hillen and Berens, 1994), which guarantees tight repression under circumstances in which expression is unnecessary (Orth *et al*., 2000). Furthermore TetR shows high affinity for its effector tetracycline, and is capable of recognizing this antibiotic at extremely low concentrations in order to mediate derepression (Orth *et al*., 2000). The use of the *tetO* operator and TetR has found new applications not only in a wide range of Gram-negative and Gram-positive microorganisms, but also in eukaryotic cells. The review provides details on novel *tet*-controllable artificial or hybrid promoters for targeted gene expression. In turn, this can be controlled by regulators expressed at different levels either constitutively or in an auto-regulated manner. In line with modern developments is the proposal to the use TetR as a regulatory device in synthetic biology. Altogether the review explains the potential use of TetR in prokaryotes.

Three articles in the first issue from the laboratories of Van Beeumen, Wick and Ramos (Böltner *et al*., 2008; Brigé *et al*., 2008; Shi *et al*., 2008) deal with the potential of microorganisms to remove pollutants. Brigé and colleagues (2008) elegantly show that the *Shewanella oneidensis* is capable of attacking a number of dyes based on an extracellular reduction process that requires a complex electron reduction transfer pathway located on the cell membranes of this microorganism. The identification of the proteins that are involved is based on a classical but elegant 'loss-of-function' approach based on targeted transposon mutagenesis and identification of mutants unable to decolorize textile dyes such as diazo dyes and oxazine. The authors also show that the melanin excreted by *Shewanella* cells can enhance the process by acting as an electron shuttle molecule.

Wick's group formerly showed that microorganisms with biodegradative properties can form biofilms on anthracene particles to facilitate its degradation. In Shi and colleagues (2008) Wick's laboratory deals with the potential use of a hybrid technology that combines bioremediation and electrokinetics for the treatment of contaminated soils, and suggests that ATP levels of *Sphingomonas* sp. LB126 exposed to direct current can be up to 60% higher than the intracellular ATP levels of untreated cells. Should this technology find its way into *in situ* applications, it would mean a real revolution in the field.

*For correspondence. E-mail info@bio-iliberis.com; Tel. (+34) 646404152.

Lindane is known to be a persistent pollutant and Nagata and colleagues in Japan and several other groups worldwide have reported bacteria of the genus *Sphingomonas* to be able to mineralize lindane (Nagata *et al*., 1993; Mertens *et al*., 2006). Böeltner and colleagues (2008) in this first issue of *Microbial Biotechnology* have managed to successfully adapt a strategy that combines biodegradation and the bacteria ability to colonize the roots of plants. The approach results in the isolation of novel *Sphingomonas* strains that are relatively efficient in the removal *in situ* of this pesticide. The experiments report greenhouse tests and are of great value for future field assays. The value of this study derives from the author's own experience in the failure of previous isolates to work *in situ*. Hence, rhizoremediation of lindane offers promising perspectives for the biotreatment of open polluted sites.

The article by Beggah and colleagues (2008) dealing with the mutagenesis of HbpR regulator is closely related to biodegradation. The HbpR protein controls the expression of the *hbp* genes for the degradation of 2-hydroxybiphenyl. HbpR belongs to NtrC family of regulators that includes XylR and PhhR which control catabolic pathways for the degradation of toluene and phenol, respectively, and are able to achieve altered effector specificity (Ramos *et al*., 1997; Shingler, 2003). Beggah and colleagues (2008) gracefully show that it is possible to generate a wide collection of mutants with altered effector specificity in a single round of mutagenesis of the domain involved in effector interactions. To this end authors make use of the potential of error-prone PCR mutagenesis and of a selection system based on *Escherichia coli* that expresses the green fluorescent protein in an HbpR-dependent manner. Thus several mutants with the ability to recognize 2-chlorobiphenyl were found. This technology has great potential for the evolution of catabolic pathways (Ramos *et al*., 1987) and the construction of hybrid pathways for the degradation of persistent pollutants.

Two articles in this first issue deal with pathogens. Microbial biotechnology offers the possibility of identifying new targets for antimicrobials, and this field is attracting considerable funding and research efforts. The article by Berthet and colleagues (2008) deals with a critical issue for the treatment of infections: the rapid identification of pathogens. The authors present a method that allows the unequivocal identification of a wide range of bacteria and viruses in 10 h and predicts antibiotic resistance, pathogenicity and virulence profiles. The example used to validate the new methodological approach was based on the identification of the monkey-pox virus and the drug-resistant *Staphylococcus aureus* from a skin lesion of a child suspected of orthopox virus infection. This technology can be easily transferred to a clinical setting. The rapid and unbiased identification of pathogens ensures that the most appropriate treatment is applied.

The second article dealing with pathogens turned out to be a great surprise for us as it reports that a 'classical' opportunistic human pathogen is able to provoke a disease to plants such as barley and poplar trees. The article goes beyond the description of human pathogens such as *Salmonella enterica* attacking and colonizing plants (Gibson *et al*., 2006). Attila and colleagues (2008) present in this first issue of *Microbial Biotechnology* an impressive study showing that a number of specific genes of *Pseudomonas aeruginosa* are induced in response to plant exudates and that certain plant genes are induced in response to the presence of the bacteria in the root system of plants. The study by Attila and colleagues (2008) and that by Matilla and colleagues (2007) allow the identification of chemotaxis genes, biofilm-related genes, genes for the transport of nutrients and stress genes, as part of the specific set of bacterial genes induced in response to the plant. These two articles are at the start of the expansion of new genomic approaches in the study of plant–microbe interactions.

A second article from Wood's laboratory in this issue deals with the construction of a number of *E. coli* mutants that allow to increase hydrogen production from formate up to almost 150-fold (Maeda *et al*., 2002). The authors exploit the wide range of tools available for enteric bacteria to produce sequential mutants that exhibit the highest ever described rates of hydrogen production and with a close theoretical rate of production. The mutant also exhibited an increase in about 50% for hydrogen production from glucose. The introduced mutations include the specific alteration of the regulation of formate lyase for the synthesis of hydrogen from formate, the strain exhibited knock-outs in uptake hydrogenases 1 and 2 and re-directed formate metabolism using a number of mutants.

Last but not least the scientific community cannot be but grateful for the initiative on the web alert on issues of biotechnological interest by Larry Wackett (2008). On this occasion Dr Wackett has shed light on 17 functions related to the synthesis of chiral compounds. To conclude we hope that *Microbial Biotechnology* will reach its objective of being the leading journal in the field, and we could say that the entire first issue of *Microbial Biotechnology* offers a wide range of research articles for those interested in the exploitation of microorganisms.

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