Microbial Biotechnology (2008) **1**(5), 343–344 doi:10.1111/j.1751-7915.2008.00052.x

Editorial

Limits in energy generation and biotechnology of primary and secondary products

Juan L. Ramos,[1,2]* Ana Sanchez de la Campa,[1] Paloma Pizarro-Tobias,[3] Matilde Fernández,[3] Pieter van Dillewijn[2] and Craig Daniels[2]
[1]*Department of Environmental Biotechnology, CSIC, Granada, Spain and Unidad Asociada CSIC-Universidad de Huelva, Huelva, Spain.*
[2]*Estacion Experimental del Zaidín, Granada, Spain.*
[3]*Bio-Iliberis R&D, Parque Tecnológico Campo de la Salud, Armilla, Granada, Spain.*

At the present time we are exposed to continuous increases in the cost of a barrel of crude oil; in fact, recently the prices have reached highs that were never thought possible. However, the truth is that these price increases have been a continuous issue over the last 10 years. The demands for petroleum to use in energy generation and the synthesis of thousands of chemicals used to manufacture goods have led governments to direct their research efforts towards green chemistry and the search for alternative energy sources. One of these alternative energy sources are biofuels. The question of biofuels is a hot issue today and this has been clearly reflected during the short life of *Microbial Biotechnology*, which has published key articles (Vardar-Schara *et al*., 2008), reviews (Wacket, 2008a) and guest commentaries (Fernández *et al*., 2008; Rojo, 2008) related to this matter. An article currently in press in *Microbial Biotechnology* (Veit *et al*., 2008) deals with a model system for hydrogen production. The host system they describe is *Escherichia coli* BD21, a strain that exhibits no hydrogen consumption and constitutes an ideal model for studies on the thermodynamic limits of the process and its yield. The 'hydrogen factory' described by Veit and colleagues (2008) is a heterologous complex made of a 4Fe-4S ferredoxin coupled to a hydrogenase. The authors conclude that glucose is an excellent substrate for high hydrogen yield and that the system requires refinements and improvements before it can be translated into an industrial project. Even so, we expect bioproduction of hydrogen can contribute to alleviate energy demands, particularly when it is generated from waste products so that a double effect is accomplished, namely cleaner wastes and a highly value-added product.

In the July issue of *Microbial Biotechnology* there appeared an article by Siezen and Khayatt (2008) that provided an in-depth summary of the current state of knowledge regarding the biosynthesis of natural products in bacteria. Initially the authors describe in detail two of the major multi-modular or multi-domain proteins termed non-ribosomal peptide synthetases (NRPS) and polyketide synthases (PKS) that are involved in the synthesis of secondary metabolites. Emphasis is placed on the recent increase in whole microbial genome sequencing and the use of numerous programmes and web-based tools that are available for *in silico* genome screening. They report on the analysis of the 140 most recently sequenced microbial genomes for the presence of NRPS and PKS systems and conclude that genomes from environmental isolates (soil and aquatic) tend to contain multiple (three or more) systems.

They provide information describing both classical and novel high-throughput experimental screening techniques that can be employed to elucidate the natural products synthesized by the newly discovered gene clusters for NRPS and PKS systems. Clearly, this is a very important arm of current microbial research. At present numerous novel natural products are used in medicine: the epothilone anticancer metabolite from *Sorangium cellulosum*, anti-tuberculosis agent streptomycin from *Streptomyces griseus* and staurosporine from *Salinispora tropica* to name a few. Continued genome mining for gene clusters able to produce novel bioactive secondary metabolites followed by in-depth characterization of the structures and activities of the products is required, the results of which may potentially lead to the use of such molecules in agriculture, and biotechnology on top of those currently used in medicine.

Should you wish to get a taste of biotechnology, do not hesitate to read the review by Sergio Sánchez and Arnold Demain. This delightful review (Sánchez and Demain, 2008) gives the reader a ride through the large number of biotechnological processes involved in the production of primary products. The review introduces the reader to

*For correspondence. E-mail juanluis.ramos@eez.csic.es; Tel. (+34) 958 (181608); Fax (+34) 958 (135740).

who produces what, how the goods are produced, what products are most important and what the added-value is to the product. The authors manage this without leaving aside the role of biological enzymes in the production of region- and stereo-specific products versus more isomer-like chemical production. It is in the added-value of products where the biological processes gain importance, as competition with classical chemistry is still limited in terms of volumetric production. Naturally, concerns about global warning and energy production have intensified interest in exploitation of primary metabolism for new high-energy compounds. In a recent article in *Nature* Atsumi and colleagues (2008) have shown that certain 2-keto acids, which are key metabolites for amino acid biosynthesis, can be a source from which to generate butanol, phenylethanol and other highly energetic compounds that resemble hydrocarbons present in gasoline and diesel. Clearly, the physiology of new environmental isolates can reveal innovative possibilities in energy generation.

Continuing on the theme of environmental issues, Magrisso and colleagues (2008) review the advantages of using genetically tailored microorganisms as sensors for pollution; in this case metal bio-accessibility. Such biosensors respond to the presence of a target compound producing a quantifiable signal, often luminescence or fluorescence, which are means to measure the bioavailability of metals. This review, together with the recent description by Wackwitz and colleagues (2008) on the use of internal markers for bioreporter cell lines, will contribute to the consolidation of biosensor technology in the international markets. To complete the panorama on biosensors Larry Wacket (2008b) provides in his web alert section even more fascinating details that will appeal to the reader interested in current biosensor technology.

References

Atsumi, S., Hanai, T., and Liao, J.C. (2008) Non-fermentations pathways for synthesis of branched-chain higher alcohols as biofuels. *Nature* **451:** 86–89.

Fernández, M., Pizarro-Tobias, P., and de Genéve, J. (2008) Energy, heat, flavours and aromas of *Microbial Biotechnology*. *Microb Biotechnol* **1:** 199–201.

Magrisso, S., Erel, Y., and Belkin, S. (2008) Microbial reporters of metal bioavailability. *Microb Biotechnol* **1:** 320–330.

Rojo, F. (2008) Biofuels from microbes: a comprehensive view. *Microb Biotechnol* **1:** 208–210.

Sánchez, S., and Demain, A. (2008) Metabolic regulation and overproduction of primary metabolites. *Microb Biotechnol* **1:** 283–319.

Siezen, R.J., and Khayatt, B.I. (2008) Natural products genomics. *Microb Biotechnol* **1:** 275–282.

Vardar-Schara, G., Maeda, T., and Wood, T.K. (2008) Metabolic engineering for production hydrogen via fermentation. *Microb Biotechnol* **1:** 107–125.

Veit, A., Akhtar, M.K., Mizutani, T., and Jones, P.R. (2008) Constructing and testing the thermodynamic limits of synthetic NAD(P)H:H2 pathway. *Microb Biotechnol*. doi:10/1111/j1751-7915.00033.x.

Wacket, L.P. (2008a) Microbial-based motor fuels: science and technology. *Microb Biotechnol* **1:** 211–225.

Wacket, L.P. (2008b) Biosensors. An annotated selection of World Wide Web sites relevant to the topics in environmental microbiology. *Microb Biotechnol* **1:** 331–332.

Wackwitz, A., Harms, H., Chatzinotas, A., Breuer, U., Vogne, C., and van der Meer, J.R. (2008) Internal arsenite bioassay calibration using multiple bioreporter cell lines. *Microb Biotechnol* **1:** 149–157.

