

# Dynamic Biochemistry, Process Biotechnology and Molecular Biology

**Abbreviation:** Dyn. Biochem. Process Biotech. Mol. Biol.

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**Scope and target readership:** *Dynamic Biochemistry, Process Biotechnology and Molecular Biology* receives papers in which biochemical, molecular biology, biophysical, bioinformatic, genomic and proteomic approaches (preferably multidisciplinary) to study any aspect of biotechnology:

- 1) Biochemical and bioprocess engineering; Industrial processes/new products; Modelling and scale-up of laboratory processes;
- 2) Biominerals (metal ions, metal chelates, siderophores, metal-containing proteins) in biology, biochemistry and medicine;
- 3) Biotechniques and medical biotechnology (new techniques for cell culture or *in vitro* systems, environmental control, flow cytometry/analysis, spectroscopy and fluorescence, immunology, high throughput screening/drug discovery, DNA sequencing/arrays, genomics and proteomics);
- 4) Biotherapy and bioengineering (production of enzymes, vitamins, and other biologically active substances; studies on the processing of raw materials; and the microbiological synthesis of food and feed products);
- 5) Cybernetics in biological systems (information processing in organisms, including sensory, motor, cognitive, and ecological phenomena: quantitative modelling; computational, technical, or theoretical studies with relevance for understanding biological information processing; and artificial implementation of biological information processing and self-organizing principles);
- 6) Cytotechnology (**(a)** derivation, genetic modification, characterization of cell lines, genetic and phenotypic regulation, control of cellular metabolism, cell physiology and biochemistry related to cell function, performance and expression of cell products; **(b)** Cell culture techniques, substrates, environmental requirements and optimization, cloning, hybridization and molecular biology, including genomic and proteomic tools; **(c)** Cell culture systems, processes, reactors, bio-reactors, scale-up, and industrial production (up- and down-stream). Descriptions of the design or construction of equipment, media or quality control procedures, that are ancillary to cellular research. **(d)** The application of cells in differentiation, cancer research, immunology, genetics, senescence, inflammatory and viral disease and other medical and veterinary investigations, including application in gene therapy and tissue engineering. **(e)** The use of cell cultures as a substrate for bioassay, cytotoxicity and pharmacology measurement, biomedical applications and in particular as a replacement for animal models;
- 7) Metabolomics and molecular biology (metabolite target analysis, metabolic profiling and metabolic fingerprinting; improvements in data preparation, storage, curation and analyses; comparative integrated studies with transcriptomics and proteomics including within a systems biology context; and the application of metabolomics as it relates to man, animals and plants; Nucleic acids;
- 8) Nanoscience;
- 9) Physiology/biochemistry;
- 10) Robotics for life systems (artificial brain research, artificial intelligence and control, minds and brain science, artificial life or living, chaos, cognitive science, complexity, computer graphics, evolutionary computations, fuzzy control, genetic algorithms, innovative computations, micromachines, micro-robots, neural networks, neurocomputers, neurocomputing technologies and applications, virtual engineering, and virtual reality;
- 11) Space research;
- 12) Sustainable (bio)production systems;
- 13) Systems biology;
- 14) Tissue banking (quality assurance and control of banked cells/tissues, effects of preservation and sterilisation methods on cells/tissues, biotechnology, clinical applications; standards of practice in procurement, processing, storage and distribution of cells/tissues; ethical issues; medico-legal issues);
- 15) Xenotransplantation (organ and tissue transplantation across species barriers): controversial theological, ethical, legal and psychological implications.

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**Cover photos:** Viability assessment: by colony counting on an agar plate (right) and fluorescence microscopy (left). Entrance of specific fluorescence dyes in the cells depends on their state, thus distinguishing viable from non-viable cells. More details in de Carvalho and da Fonseca, pp 32-39.

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## CONTENTS

<b>Marcos A. das Neves, Toshinori Kimura, Naoto Shimizu, Mitsutoshi Nakajima (Japan)</b> State of the Art and Future Trends of Bioethanol Production	1
<b>Catherine Charcosset, Samuel Bernard, Koffi Fiaty, Mikhael Bechelany, David Cornu (France)</b> Membrane Techniques for the Preparation of Nanomaterials: Nanotubes, Nanowires and Nanoparticles – A Review	15
<b>L. Rashidi, J. Towfighi Dariani, K. Khosravi-Darani (Iran)</b> Biodesulfurization: Biochemical and Genetic Engineering Aspects	24
<b>Carla C.C.R. de Carvalho, M. Manuela R. da Fonseca (Portugal)</b> Bacterial Whole Cell Biotransformations: <i>In Vivo</i> Reactions Under <i>In Vitro</i> Conditions	32
<b>Marta M. Rubio-Teixeira (USA)</b> Milk: Microbes' Heaven Making Human's Paradise	40
<b>David J. Timson (UK)</b> Galactose Metabolism in <i>Saccharomyces cerevisiae</i>	63
<b>Perihan Guler, Aysun Ergene, Sema Tan (Turkey)</b> Grain Spawn Production in <i>Agaricus bitorquis</i> (Quél.) Sacc.	74
<b>Torsten Kleffmann (New Zealand), Wilhelm Gruissem, Sacha Baginsky (Switzerland)</b> plprot: The Plastid Proteome Database	79
<b>V.S.S. Prasad, S. Dutta Gupta (India)</b> Photometric Clustering of <i>In Vitro</i> Regenerated Plants of <i>Gladiolus</i> Using Fuzzy Adaptive Resonance Theory (Fuzzy ART) Neural Network	84

● **Dynamic Biochemistry, Process Biotechnology and Molecular Biology, VOLUME 1, NUMBER 1, 2007**

**Marcos A. das Neves, Toshinori Kimura, Naoto Shimizu, Mitsutoshi Nakajima (Japan)** State of the Art and Future Trends of Bioethanol Production (pp 1-14)

**ABSTRACT**

**Special Feature:** With efforts to reduce global reliance on fossil fuels and lower the greenhouse gas emission, an increasing search for renewably sourced materials, which can be used as feedstock for biofuel production, is ongoing in the past few decades. At the present, ethanol is the most common alternate fuel and is already produced on a fair scale, representing a sustainable substitute for gasoline in passenger cars. Basically, in Brazil ethanol is produced through the fermentation of sugar cane molasses. In the United States ethanol is produced by fermenting starch crops that have been converted into simple sugars, and the major feedstock for this fuel is corn. Various countries have been increasing their ethanol production as well, such as India (using sugar cane), Thailand (cassava), France (sugar beet), China (corn) and Canada (wheat), among others. Though these agricultural commodities are major issues for both food and fuel economies, they are likely to be insufficient in the near future, presenting great challenges for food processors and biofuels producers in the 21<sup>st</sup> century. Alternatively, the conversion of cellulosic material into ethanol is relatively low up to date, compared to sugar or starch crops, leading the need to develop fermentation processes that can convert energy crops, such as grasses, and agricultural by-products, such as straw and corn stover, into bioethanol, allowing high conversion of both hexoses and the difficult to ferment pentoses into ethanol at high yields. Therefore, the search for technological breakthrough is on the high, aiming to develop technologies for effectively converting agricultural and forestry lignocellulosic residues to fermentable sugars.

**Catherine Charcosset, Samuel Bernard, Koffi Fiatty, Mikhael Bechelany, David Cornu (France)** Membrane Techniques for the Preparation of Nanomaterials: Nanotubes, Nanowires and Nanoparticles – A Review (pp 15-23)

**ABSTRACT**

**Invited Review:** The large interest in nanostructures results from their numerous potential applications in various areas such as biomedical sciences, composite materials, electronic, optic, magnetism, energy storage, and electrochemistry. The present review deals with the preparation of nanomaterials including nanotubes, nanowires and nanoparticles on the basis of two processes using membranes as shaping tools: the membrane template method and the membrane contactor. This report is focused on a description of the type of membranes and of the synthesis techniques which are used to produce a large variety of nanomaterials in terms of morphology and chemical composition. In the membrane template method, a nanoporous membrane with oriented nanochannels is used as mould (hard template) and filled with the desired material or precursors. Subsequently, the membrane is removed to generate a panel of desired nanostructures (nanotubes or nanowires) with a size-replication effect. The spatial distribution of the ensuing nanoobjects is governed by the pore distribution in the starting membrane. In the second process, the membrane contactor, a first solution flows tangentially to the membrane surface and then mixes/reacts with a second solution coming from the membrane pores. Using this technique, polymeric nanoparticles, solid lipid nanoparticles, and nanocrystals have been prepared. Selected examples will be presented.

**L. Rashidi, J. Towfighi Dariani, K. Khosravi-Darani (Iran)** Biodesulfurization: Biochemical and Genetic Engineering Aspects (pp 24-31)

**ABSTRACT**

**Invited Mini-Review:** Biodesulfurization (BDS) offers the potential for an effective method for lowering the sulfur content of petroleum products because insufficiently desulfurized distillates of petroleum products is a significant source of environmental pollution. This review describes the development of BDS; and compares destructive and non-destructive pathways as well as aerobic and anaerobic BDS. The process variables affecting growth and activity of microorganisms of BDS are described. Also genetic modifications and bioreactor designs, which lead to an increased BDS efficiency and commercial aspects, are discussed. Finally, the critical factor for industrial application of BDS as an efficient process is an adequate bioreactor design. The application of mixtures of biocatalysts is necessary for an efficient desulfurization of crude oil containing a wide range of sulfur compounds.

**Carla C.C.R. de Carvalho, M. Manuela R. da Fonseca (Portugal)** Bacterial Whole Cell Biotransformations: *In Vivo* Reactions Under *In Vitro* Conditions (pp 32-39)

#### ABSTRACT

**Invited Mini-Review:** Wild and recombinant bacterial strains are able of carrying out biocatalysis and biotransformation processes involving multi-step metabolic pathways with co-factor regeneration. Bacterial cell tolerance and adaptation to organic solvents, ionic liquids and other non-conventional conditions, have allowed the biotransformation of low water soluble substrates and the production of high valued compounds. The recent developments in single cell monitoring, namely by fluorescence microscopy and flow cytometry, have resulted in increased yields and extended operation of processes for the biotransformation of toxic compounds. In this review, the utilisation of wild and recombinant strains will be discussed as well as the recent developments in metabolic engineering of bioconversion processes. The application of cells in non-conventional media and its repercussion in process design will be reviewed and the importance of studying cell viability will be presented.

**Marta M. Rubio-Teixeira (USA)** Milk: Microbes' Heaven Making Human's Paradise (pp 40-62)

#### ABSTRACT

**Invited Review:** Milk is one of the most complete nutrient sources evolved in nature to enable the successful development of mammalian offspring. Given its particular richness, it is not surprising the fact that, almost as ancient as the origin of milk, so is its colonization by microorganisms. Different types of bacteria, yeast, and moulds, have adapted their lifestyles to favor their continued survival on this ecological niche. Success of such a diverse community largely depends upon the establishment of tight symbiotic relationships. Milk microorganisms have learned to survive on milk by relying on each other's metabolisms. Certain microbes have the ability to metabolize the relatively complex milk carbon source lactose, releasing simpler carbon compounds as byproducts that can then be assimilated by other species. Other microorganisms have, instead, strong lipolytic and proteolytic activities that help the rest of the community to assimilate the fat and proteins present on milk. But no relationship is idyllic, for the members of this community have also developed defensive mechanisms that strictly select their neighbors while keeping potential enemies at bay. As a result of this complex microbial interaction, important changes occur in the structure and organoleptic properties of milk. And there is yet, a third organism, which importantly contributes to the maintenance of an equilibrium within this particular ecosystem and this is precisely our own kind, which for thousands of years, and long before noticing the existence of these microscopic world, has learned to take further nutritional advantage of milk by favoring its microbial communities to thrive on it while generating what we most commonly know as dairy products. This review reexamines the historical origin and types of dairy products derived from the interaction of different groups of microbes able to survive on milk, with a particular focus on the milk yeasts populations and the main physiological characteristics that have allowed their exceptional adaptation to life in a nutritious but rather complex medium. An ultimate emphasis is also placed in the latest scientific advances that are allowing further improvements in many desirable characteristics of milk and dairy products such as their beneficial effect on health, by means of technologies involving the metabolic engineering of dairy microbes.

**David J. Timson (UK)** Galactose Metabolism in *Saccharomyces cerevisiae* (pp 63-73)

#### ABSTRACT

**Invited Review:** Galactose is metabolised to the more metabolically useful glucose 6-phosphate by the enzymes of the Leloir pathway. This pathway is necessary as the initial enzymes of glycolysis are unable to recognise galactose. In most organisms, including *Saccharomyces cerevisiae*, five enzymes are required to catalyse the conversion: galactose mutarotase, galactokinase, galactose 1-phosphate uridylyltransferase, UDP-galactose 4-epimerase and phosphoglucomutase. The pathway has attracted interest in *S. cerevisiae* as it is under very strict genetic control and thus provides an excellent model for the study of gene expression in eukaryotes. In the presence of glucose the genes encoding the Leloir pathway enzymes (the *GAL* genes) are completely repressed through the action of a transcription factor Mig1p. Only in the presence of galactose and the absence of glucose do the concerted actions of Gal4p, Gal80p and Gal3p enable the rapid and high level activation of the *GAL* genes. The exact mechanism of action of these three proteins is controversial. Galactose metabolism in *S. cerevisiae* is also of interest because it can be exploited both in the laboratory (for high level expression of heterologous proteins and in the yeast two hybrid screen) and industrially (increasing flux through the Leloir pathway in order to make more efficient use of feedstocks with high galactose content). Recent work on the structures of the various proteins, their mechanisms of action and attempts to gain an integrated understanding of transcriptional and metabolic events will assist our understanding of both the fundamental biochemical processes and how these might be exploited commercially.

**Perihan Guler, Aysun Ergene, Sema Tan (Turkey)** Grain Spawn Production in *Agaricus bitorquis* (Quél.) Sacc. (pp 74-78)

#### ABSTRACT

**Original Research Paper:** In this study the production of grain spawn prepared from *Agaricus bitorquis* (Quél.) Sacc., mycelium germinated at different temperatures was investigated. *A. bitorquis* fructifications collected from nature were grouped as A, B, C, D, and E. Malt extract agar was used as the agar media. The basidiospores of all five groups were germinated by a multispore method in malt extract agar in Petri dishes and primer mycelium was obtained. The mycelia agar discs were taken from primer mycelium and transferred to malt extract agar in Petri dishes and were developed at 30°C, 32°C, 34°C, 36°C, and 38°C separately, and secondary mycelium was obtained. For mycelium development the optimal temperature was 30°C and was therefore used as the control group. Grain spawn was prepared from this secondary mycelium. The wheat grains used for spawn production were incubated in 85-90% humidity and at 30°C. In the production of grain spawn the mycelia began to develop during the first and second shaking period, eventually covering the wheat grains completely. The covered mycelium was then incubated in the refrigerator and a grain spawn calendar was prepared.

**Torsten Kleffmann (New Zealand), Wilhelm Gruissem, Sacha Baginsky (Switzerland)** plprot: The Plastid Proteome Database (pp 79-83)

#### ABSTRACT

**Techniques Paper:** Plant plastids develop and differentiate in a tissue-specific and signal-dependent manner. Each plastid type contains a distinct set of enzymes for specialized functions and metabolic activities. plprot was established as a plastid proteome database to provide information about the proteomes of chloroplasts, etioplasts, chromoplasts and the undifferentiated plastids from a tobacco BY2 cell culture and currently features 2793 protein entries. plprot furthermore provides an interactive rice etioplast proteome map that allows protein quantification and the analysis of proteome dynamics during light-induced etioplast to chloroplast conversion. plprot was designed to make all data readily accessible via a user friendly database interface and a BLAST-search module. plprot is available at <http://www.plprot.ethz.ch>.

**V.S.S. Prasad, S. Dutta Gupta (India)** Photometric Clustering of *In Vitro* Regenerated Plants of *Gladiolus* Using Fuzzy Adaptive Resonance Theory (Fuzzy ART) Neural Network (pp 84-88)

#### ABSTRACT

**Original Research Paper:** The application of Fuzzy ART as a clustering method is described to group regenerated gladiolus plants in terms of their similarity in leaf trichromatic features. The clustering results of Fuzzy ART were compared with the ART 2 modeling approach. The incorporation of fuzzy sets into the ART neural network enabled efficient clustering by refining grouping of leaf input patterns. The vigilance parameter considerably affected the number of generated clusters. A vigilance parameter of 0.91 was chosen as optimal into which the training and test set input patterns could be clustered into 7 and 5 distinct groups, respectively. The approach might provide scientists with a software sensor which can be used in selecting plants suitable for *ex vitro* transfer and in the quality control of micropropagation.