

CONTENTS

Bioreactors and Plants

- | | | |
|----|---|----|
| A1 | Optimisation of product yield in immobilised plant cell cultures
M. A. HOLDEN and M. M. YEOMAN (<i>University of Edinburgh, UK</i>) | 1 |
| A2 | Growth and product formation by plant cell suspensions cultivated in bioreactors
A. H. SCRAGG, P. BOND, F. LECKIE, R. CRESSWELL, M. W. FOWLER (<i>University of Sheffield, UK</i>) and E. J. ALLAN (<i>University of Aberdeen, UK</i>) | 12 |
| A3 | Production of secondary metabolites by immobilised plant cells in novel bioreactors
F. MAVITUNA, A. K. WILKINSON, P. D. WILLIAMS (<i>UMIST, Manchester, UK</i>) and J. M. PARK (<i>University of Minnesota, USA</i>) | 26 |
| A4 | Fermentation studies of transformed root cultures
P. D. G. WILSON, M. G. HILTON, R. J. ROBINS and M. J. C. RHODES (<i>AFRC Institute of Food Research, Norwich, UK</i>) | 38 |
| A5 | Seed preparation for rapid germination—engineering studies
A. W. NIENOW (<i>University of Birmingham, UK</i>) and P. A. BROCKLEHURST (<i>AFRC Institute for Horticultural Research, Wellesbourne, UK</i>) | 52 |

Bioreactor Control

- | | | |
|----|--|----|
| B1 | Bioreactor control and modeling: a simulation program based on a structured population model of budding yeast
L. CAZZADOR (<i>LADSEB-CNR, Padova, Italy</i>), L. ALBERGHINA, E. MARTEGANI (<i>University of Milan, Italy</i>) and L. MARIANI (<i>University of Padova, Italy</i>) | 64 |
|----|--|----|

- B2 On-line measuring methods for the control of the fluid dynamic behaviour of bioreactors 76
A. LÜBBERT, B. LARSON and T. KORTE (*University of Hanover, Federal Republic of Germany*)
- B3 A calorimetric study of microbial growth energetics 87
U. VON STOCKAR, I. W. MARISON and B. BIROU (*Swiss Federal Institute of Technology, Lausanne, Switzerland*)

Bioreactors and Animal Cells

- C1 Immobilisation and growth of hybridomas in packed beds 99
A. D. MURDIN, J. S. THORPE, N. KIRKBY, D. J. GROVES and R. E. SPIER (*University of Surrey, UK*)
- C2 The development of a large scale production process for tissue culture products 111
P. J. WILKINSON (*Celltech Ltd, Slough, UK*)
- C3 Two ceramic matrices for the long-term growth of adherent or suspension cells: scalability 121
G. G. PUGH, G. J. BERG (*Charles River Biotechnical Services, Inc., Wilmington, MA, USA*) and C. H. J. SEAR (*Charles River Biotechnical Services Ltd, Margate, UK*)
- C4 Production of biomolecules by cells cultured in tri-dimensional collagen microspheres 132
E. G. HAYMAN, N. G. RAY and P. W. RUNSTADLER JR (*Verax Corporation, Lebanon, NH, USA*)

Combined Bioreaction and Separation

- D1 A novel method for the production of dextran and fructose 141
P. E. BARKER, I. ZAFAR (*Aston University, UK*) and R. M. ALSOP (*Fisons Pharmaceuticals plc, Crewe, UK*)
- D2 Bioreactors for anaerobic bacteria and gene-engineered bacteria with cross-flow filtration 158
T. KOBAYASHI (*Nagoya University, Japan*)

- D3 A novel membrane module for use in biotechnology that has high transmembrane flux rates and low fouling 166
J. M. WYATT (*BMP Ltd, Abingdon, UK*), C. J. KNOWLES (*University of Kent, UK*) and B. J. BELLHOUSE (*Oxford University, UK*)
- D4 Effects of biomass recycle on the performance of biotransformation fermentations using mutant organisms 173
J. HUBBLE and S. JOYCE (*University of Bath, UK*)

Bioconversions in Novel Media

- E1 Biocatalysis in low water, predominantly organic reaction mixtures 189
P. J. HALLING (*University of Strathclyde, UK*)
- E2 Halo-fermentation, a novel low water process for the production of organic chemicals and enzyme protective agents 201
E. A. GALINSKI (*Institute for Microbiology, Bonn, Federal Republic of Germany*)

Biotransformations (Products)

- F1 Enzymatic reduction of beta-ketoesters using immobilised yeasts 213
M. CHRISTEN and D. H. G. CROUT (*University of Warwick, UK*)
- F2 Microbial transformation of isoprenoid hydrocarbons and related compounds 219
K. NAKAJIMA (*Fermentation Research Institute, Ibaraki, Japan*)
- F3 The application of organic solvents for the bioconversion of benzene to *cis*-benzeneglycol 231
W. J. J. VAN DEN TWEEL, E. H. MARSMAN, M. J. A. W. VORAGE, J. TRAMPER and J. A. M. DE BONT (*Agricultural University, Wageningen, The Netherlands*)

Biotransformations (Processes)

- G1 Achieving specificity with alkane monooxygenases 242
D. J. LEAK (*Imperial College of Science and Technology, London, UK*)

- D3 A novel membrane module for use in biotechnology that has high transmembrane flux rates and low fouling 166
J. M. WYATT (*BMP Ltd, Abingdon, UK*), C. J. KNOWLES (*University of Kent, UK*) and B. J. BELLHOUSE (*Oxford University, UK*)
- D4 Effects of biomass recycle on the performance of biotransformation fermentations using mutant organisms 173
J. HUBBLE and S. JOYCE (*University of Bath, UK*)

Bioconversions in Novel Media

- E1 Biocatalysis in low water, predominantly organic reaction mixtures 189
P. J. HALLING (*University of Strathclyde, UK*)
- E2 Halo-fermentation, a novel low water process for the production of organic chemicals and enzyme protective agents 201
E. A. GALINSKI (*Institute for Microbiology, Bonn, Federal Republic of Germany*)

Biotransformations (Products)

- F1 Enzymatic reduction of beta-ketoesters using immobilised yeasts 213
M. CHRISTEN and D. H. G. CROUT (*University of Warwick, UK*)
- F2 Microbial transformation of isoprenoid hydrocarbons and related compounds 219
K. NAKAJIMA (*Fermentation Research Institute, Ibaraki, Japan*)
- F3 The application of organic solvents for the bioconversion of benzene to *cis*-benzeneglycol 231
W. J. J. VAN DEN TWEEL, E. H. MARSMAN, M. J. A. W. VORAGE, J. TRAMPER and J. A. M. DE BONT (*Agricultural University, Wageningen, The Netherlands*)

Biotransformations (Processes)

- G1 Achieving specificity with alkane monooxygenases 242
D. J. LEAK (*Imperial College of Science and Technology, London, UK*)

G2	Biotransformations of di- and trichlorinated benzenes	253
	G. SCHRAA and J. R. VAN DER MEER (<i>Agricultural University, Wageningen, The Netherlands</i>)	
G3	Bioelectrochemical transformations catalysed by <i>Clostridium sporogenes</i>	263
	R. W. LOVITT (<i>University College, Swansea, UK</i>), E. W. JAMES, D. B. KELL and J. G. MORRIS (<i>University College of Wales, Aberystwyth, UK</i>)	
G4	Bioconversions in permeabilized cells	277
	H. R. FELIX (<i>Sandoz Ltd, Basel, Switzerland</i>)	

Novel Bioreactors

H1	The centrifugal field bioreactor—a new reactor to obtain higher productivities during aerobic fermentations, especially in high viscous pseudoplastic fermentation broths	287
	H. VOIT and A. MERSMANN (<i>Technical University of Munich, Federal Republic of Germany</i>)	
H2	The biotechnological potential of microbial hollow-fibre bioreactors	299
	E. A. LINTON, C. J. KNOWLES, A. W. BUNCH and G. HIGTON (<i>University of Kent, UK</i>)	
H3	Enzymatic analysis of 7-phenylacetamidodeacetoxycephalosporanic acid to 7-aminodeacetoxycephalosporanic acid with immobilized penicillin amidase (EC 3.5.1.11) at laboratory and pilot plant scales using a novel type of enzymatic reactor	309
	J. P. CARDOSO (<i>Companhia Industrial Produtora de Antibióticos, Alenquer, Portugal</i>), M. B. C. DA COSTA, J. P. QUEIROGA and M. DA CONCEIÇÃO BRANDÃO (<i>Instituto Superior Técnico, Lisbon, Portugal</i>)	

Bioreactor Performance and Scale-up

I1	The design of a tubular loop reactor for scale-up and scale-down of fermentation processes	321
	B. KRISTIANSEN (<i>Center for Industrial Research, Oslo, Norway</i>) and B. MCNEIL (<i>University of Strathclyde, UK</i>)	

G2	Biotransformations of di- and trichlorinated benzenes	253
	G. SCHRAA and J. R. VAN DER MEER (<i>Agricultural University, Wageningen, The Netherlands</i>)	
G3	Bioelectrochemical transformations catalysed by <i>Clostridium sporogenes</i>	263
	R. W. LOVITT (<i>University College, Swansea, UK</i>), E. W. JAMES, D. B. KELL and J. G. MORRIS (<i>University College of Wales, Aberystwyth, UK</i>)	
G4	Bioconversions in permeabilized cells	277
	H. R. FELIX (<i>Sandoz Ltd, Basel, Switzerland</i>)	

Novel Bioreactors

H1	The centrifugal field bioreactor—a new reactor to obtain higher productivities during aerobic fermentations, especially in high viscous pseudoplastic fermentation broths	287
	H. VOIT and A. MERSMANN (<i>Technical University of Munich, Federal Republic of Germany</i>)	
H2	The biotechnological potential of microbial hollow-fibre bioreactors	299
	E. A. LINTON, C. J. KNOWLES, A. W. BUNCH and G. HIGTON (<i>University of Kent, UK</i>)	
H3	Enzymatic analysis of 7-phenylacetamidodeacetoxycephalosporanic acid to 7-aminodeacetoxycephalosporanic acid with immobilized penicillin amidase (EC 3.5.1.11) at laboratory and pilot plant scales using a novel type of enzymatic reactor	309
	J. P. CARDOSO (<i>Companhia Industrial Produtora de Antibióticos, Alenquer, Portugal</i>), M. B. C. DA COSTA, J. P. QUEIROGA and M. DA CONCEIÇÃO BRANDÃO (<i>Instituto Superior Técnico, Lisbon, Portugal</i>)	

Bioreactor Performance and Scale-up

I1	The design of a tubular loop reactor for scale-up and scale-down of fermentation processes	321
	B. KRISTIANSEN (<i>Center for Industrial Research, Oslo, Norway</i>) and B. MCNEIL (<i>University of Strathclyde, UK</i>)	

- I2 Pneumatically agitated bioreactor devices: effects of fluid height and flow area shape on hydrodynamic and mass transfer performance 335
M. Y. CHISTI and M. MOO-YOUNG (*University of Waterloo, Canada*)
- I3 Mass transfer in air-lift reactors: effects of gas recirculation 350
M. H. SIEGEL and J. C. MERCHUK (*Ben-Gurion University of the Negev, Israel*)
- I4 Hydrodynamics, axial dispersion and gas-liquid oxygen transfer in an airlift-loop bioreactor with three-phase flow 363
P. VERLAAN and J. TRAMPER (*Agricultural University, Wageningen, The Netherlands*)

Immobilisation

- J1 Immobilization of recombinant *Escherichia coli* in silicone beads 374
P. ORIEL and J. NAYINI (*Michigan State University, USA*)
- J2 Secretive fermentation of γ -linolenic acid production using cells immobilised in biomass support particles 386
H. FUKUDA and H. MORIKAWA (*Kanegafuchi Chemical Industry Co. Ltd, Hyogo, Japan*)
- J3 Enhanced performance of immobilized bioreactors using variable surface bioreactors 395
P. P. MATTEAU (*National Research Council, Ottawa, Canada*)