CONTENTS

Bioreactors and Plants

A1 Optimisation of product yield in immobilised plant cell cultures . . . 1
M. A. HOLDEN and M. M. YEOMAN (*University of Edinburgh, UK*)

A2 Growth and product formation by plant cell suspensions cultivated in bioreactors 12
A. H. SCRAGG, P. BOND, F. LECKIE, R. CRESSWELL, M. W. FOWLER (*University of Sheffield, UK*) and E. J. ALLAN (*University of Aberdeen, UK*)

A3 Production of secondary metabolites by immobilised plant cells in novel bioreactors 26
F. MAVITUNA, A. K. WILKINSON, P. D. WILLIAMS (*UMIST, Manchester, UK*) and J. M. PARK (*University of Minnesota, USA*)

A4 Fermentation studies of transformed root cultures 38
P. D. G. WILSON, M. G. HILTON, R. J. ROBINS and M. J. C. RHODES (*AFRC Institute of Food Research, Norwich, UK*)

A5 Seed preparation for rapid germination—engineering studies . 52
A. W. NIENOW (*University of Birmingham, UK*) and P. A. BROCKLEHURST (*AFRC Institute for Horticultural Research, Wellesbourne, UK*)

Bioreactor Control

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

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*)

G2 Biotransformations of di- and trichlorinated benzenes . . 253
G. SCHRAA and J. R. VAN DER MEER (*Agricultural University, Wageningen, The Netherlands*)

G3 Bioelectrochemical transformations catalysed by *Clostridium sporogenes* 263
R. W. LOVITT (*University College, Swansea, UK*), E. W. JAMES, D. B. KELL and J. G. MORRIS (*University College of Wales, Aberystwyth, UK*)

G4 Bioconversions in permeabilized cells 277
H. R. FELIX (*Sandoz Ltd, Basel, Switzerland*)

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 (*Technical University of Munich, Federal Republic of Germany*)

H2 The biotechnological potential of microbial hollow-fibre bioreactors 299
E. A. LINTON, C. J. KNOWLES, A. W. BUNCH and G. HIGTON (*University of Kent, UK*)

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 (*Companhia Industrial Produtora de Antibióticos, Alenquer, Portugal*), M. B. C. DA COSTA, J. P. QUEIROGA and M. DA CONCEIÇÃO BRANDÃO (*Instituto Superior Técnico, Lisbon, Portugal*)

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 (*Center for Industrial Research, Oslo, Norway*) and B. MCNEIL (*University of Strathclyde, UK*)

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*)