

Patents and Literature

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In our continuous effort to keep our readers updated on the recent developments in the field of biotechnology, we have compiled the Patent and Literature Review section on selected, key areas to highlight current progress in the application of biochemical knowledge. This issue's subject area is *Cells*. The patents are categorized for easy inspection and the literature section is organized in alphabetical order of the first author's name. The review covers articles and patents published from the international literature in the last twelve months. We have chosen articles and patents that we judge to be significant and interesting.

Cells

I. PATENTS

Food Related Applications

Production of L-Alanine and D-Aspartic Acid by an Immobilized Microbe; JP 8239793 A2 (Mar. 3, 1982), Tanabe Seiyaku Co., Ltd.

Isomaltulose (6-O-Alpha-D-Glucopyranosido-D-Fructose) Using Immobilized Bacterial Cells; Munir, M.; DE 3038219 A1 (Apr. 15, 1982); Sueddeutsche Zucker A.-G.

Bioconversion of Industrial Cellulosic Pulp Materials to Protein Enriched Product; Young, M. M.; US 4379844 (Apr. 12, 1983); University of Waterloo.

L-Alanine by Bacteria Immobilized in Absorbent Polyurethane Polyether Foam; Swann, W. E.; Fusee, M. C.; Calton, G. J.; FR 2490219 A1 (Mar. 19, 1982); W. R. Grace and Co.

Method for Producing L-Glutamic Acid by Fermentation; Yoshimura, M.; Takenaka, Y.; Ikeda, S.; Yoshii, H.; US 4347317 (Aug. 31, 1982); Ajinomoto Company Inc.

Amino Acid Production by Immobilized Protoplasts; JP 82144989 (Sep. 9, 1982); Ajinomoto Co. Inc.

Process for Producing L-Tryptophan, and a Pure Culture of a Microorganism Strain in Said Process; Akashiba, T.; Nakayama, A.; Murata, A.; US 4363875 (Dec. 14, 1982); Showa Denko K. K.

Method of Deacidifying Wine and Composition Therefor; Gestrelus, S. M.; Kjaer, J. H.; US 4380552 (Apr. 19, 1983); Novo Industri A/S.

Animal and Plant Cells

Production of Interferons by Human Diploid Cells; JP 8202220 A2 (Jan. 7, 1982); Toray Industries, Inc.

Microcarriers for Culturing of Anchorage Dependent Cells; Carlsson, M. E.; Lindgren, G. E. S.; Gebb-Jones, C.; European Pat. Appl. EP 66726 A1 (Dec. 15, 1982); Pharmacia Fine Chemicals AB.

Immobilization of Animal Cells; Mosbach, K. H.; Nilsson, K. G. C.; WO 8200660 A1 (Mar. 4, 1982); Corning Glass Works.

Tissue Culture Device for Mass Cell Culture, Lee, H. H.; US 4377639 (Mar. 22, 1983); University of Toledo.

Anti-Invasion Factor Containing Cultures; Kuettner, K. F.; US 4356261 (Oct. 26, 1982); Rush-Presbyterian-St. Luke's Medical Center.

Callus Culture in Nutrient Flow; Childs, A. F.; Yeoman, M. M.; Fagandini, D. A. A.; Eur. Pat. Appl. EP 52001 (May 19, 1982); Albright and Wilson Ltd.

Enhancement of In Vitro Guayule Propagation; Lovelace, A. M.; Dastoor, M. N.; Schubert, W. W.; Petersen, G. R.; US 4363188 (Dec. 14, 1982); No Assignee.

Fermentation Process for Producing Higher Plant Cells; Peel, E; Dalton, C. C.; US 4326034 (Apr. 20, 1982); The British Petroleum Company Limited.

Chemicals

Process for the Preparation of Long-Chain Dicarboxylic Acids by Fermentation; Kato, K.; Uemura, N.; US 4339536 (Jul. 13, 1982).

Production of Epoxide Using Immobilized Cells; Furuhashi, K.; Toakoa, A.; Uchida, S; CA 1132922 A1 (Oct. 5, 1982); Bio Research Center Co.

ϕ -Emulsans; Gutnick, D. L.; Rosenberg, E.; Belsky, I.; Zinaida, Z.; US 4380504 (Apr. 19, 1983); Petroleum Fermentations N. V.

Production of Epoxides Such as Propylene Oxide Using Packed Catalytic Bed Containing Moist Resting Cells Exhibiting Oxygenase Activity; Hou, C. T.; US 4348476 (Sep. 7, 1982); Exxon Research & Engineering Co.

Process for the Production of Acrylamide Using Immobilized Cells; Watanabe, I.; Sakashita, K.; Ogawa, Y.; UK Patent Application GB 2086376 A (May 12, 1982); Nitto Chemical Industry Co. Ltd.

Microbiological Production of Lower Aliphatic Carboxylic Acids; Bryant, M. P.; Genthner, B. R. S.; US 4377638 (Mar. 22, 1983); University of Patents, Inc.

Microbiological Epoxidation Process; Hou, C. T.; Patel, R. N.; Laskin, A. I.; US 4347319 (Aug. 31, 1982); Exxon Research & Engineering Co.

Microbiological Production of Novel Biosurfactants; Zajic, J. E.; Gerson, D. F.; Gerson, R. K.; Panchal, C. J.; US 4355109 (Oct. 19, 1982); No Assignee.

Steroids

Process for the Manufacture of 1 α -Hydroxydehydronepiandrosterone; Fujiwara, A.; Miyamoto, C. Okuda, T.; US 4379842 (Apr. 12, 1983); Hoffman-La Roche, Inc.

Production of Androstadienedione from Sterols by Immobilized Cells; JP 82152898 A2 (Sep. 21, 1982); Ube Industries, Ltd.

Process for the Preparation of 11-beta-Hydroxy Steroids; Petzoldt, K.; Annen, K.; Laurent, H.; Wiechert, R.; US 4353985 (Oct. 12, 1982); Schering Aktiengesellschaft

Microorganism Mutant Conversion of Sterols to Androsta-4-ene-3, 17-dione; Wovcha, M. G.; Biggs, C. B.; US 4345030 (Aug. 17, 1982); The Upjohn Company.

Techniques

Method and Apparatus for Stirring Particles in Suspension Such as Microcarriers for Anchorage-Dependent Living Cells in a Liquid Culture Medium; Cooke, G. F.; Pearson, J. M.; Eur. Pat. Appl. EP 53869 A2 (Jun. 6, 1982); Techno Cambridge Ltd.

Microorganism Immobilization with Alginates; JP 8265185 A2 (Apr. 20, 1982); Takara Shuzo Co., Ltd.

Immobilization of Microorganisms; JP 82102187 A2 (Jun. 25, 1982); Asahi Chemical Industry Co., Ltd.

Glutaraldehyde/Polyethylenimine Immobilization of Whole Microbial Cells; Lantero, O. J.; US 4355105 (Oct. 19, 1982); Miles Laboratories, Inc.

Microbes Immobilized on Kefir Granules; JP 8204311 B4 (Jan. 25, 1982); Snow Brand Milk Products Co., Ltd.

L-Aspartic Acid, Hydrophilic Polyurethane Polyether Foam and Its Use; Swann, W. E.; Fusee, M. C.; Calton, G. J.; FR 2490241 A1 (Mar. 19, 1982); W. R. Grace and Co.

Mirocapsule Containing a Microorganism and a Process for Its Production; Sozzi, T.; Schrenk, A.; Buhler, M.; US 4332790 (Jun. 1, 1982); Societe d'Assistance Technique pour Produits Nestle S. A.

Immobilization of Microorganisms in Gelled Carrageenan; Borglum, G. B.; US 4347320 (Aug. 31, 1982); Miles Laboratories.

Other

Anaerobic Digestion Process; Ishida, M.; Haga, R.; Odawara, Y.; US 4354936 (Oct. 19, 1982); The Agency of Industrial Science and Technology

Ethanol Production with an Immobilized Cell Reactor; Gaddy, J. L.; Sitton, O. C.; US 4355108 (Oct. 19, 1982); University of Missouri.

Method for Producing Ethanol with Immobilized Microorganism; Chibata, I.; Kato, J.; Wada, M.; US 4350765 (Sep. 21, 1982); Tanabe Seiyaku Co.

Biotransformations Using Methane-Utilizing Bacteria; Higgins, I. J.; US 4323649 (Apr. 6, 1982); Imperial Chemical Industries Limited.

Immobilized Micoroganisms with Beta-Tyrosinase Activity; Tysyachnaya, I. V.; Yakovleva, V. I.; Berezin, I. V.; Arens, A.; USSR, SU 922142 A1 (Apr. 23, 1982).

Immobilized Brevibacterium Containing Fumarase; Chibata, I.; Tosa, T.; Takata, I.; European Pat. Appl. EP 56111 A 1 (Jul. 21, 1982); Tanabe Seiyaku Co., Ltd.

Continuous Production of Bacteria for Leaching of Metallic Ore; Mynatt, R. L.; US 4376826 (Mar. 15, 1982); No Assignee.

Adenine Arabinoside Production by Immobilized Microbial Cells; JP 82118797 A2 (Jul. 23, 1982); Ajinomoto Co. Inc.; Kansai Paint Co., Ltd.

Microbial Transformations Using Immobilized Cells and Immobilized Cell Systems; Bolsman, T. A. B.; Bailey, M. L.; Eur. Pat. Appl. EP 54987 A1 (Jun. 30, 1982); Shell Internationale Research Maatschappij B. V.

Cells

II. LITERATURE

1. Oxygen Supply to Immobilized Cells: 1. Oxygen Production by Immobilized *Chlorella pyrenoidosa*, P. Adlercreutz and B. Mattiasson, *Enzyme Microb. Technol.* **4**, 332–336 (1982).
2. Arachidonic Acid Production by the Red Alga *Porphyridium cruentum*, T. J. Ahern, S. Katoh, and E. Sada, *Biotechnol. Bioeng.* **25**, 1057–1071 (1983).

3. Continuous Culture of *Aspergillus phoenicis* QM 329 for the Production of Cellobiase, A. L. Allen and R. L. Andreotti, *Biotechnol. Bioeng.* **24**, 2747–2752 (1982).
4. Continuous Ethanol Production and Cell Growth in an Immobilized-Cell Bioreactor Employing *Zymomonas mobilis*, E. J. Arcuri, *Biotechnol. Bioeng.* **24**, 595–604 (1982).
5. Enzyme Activity of *Arthrobacter globiformis* 193 Cells Immobilized on Macroporous Ceramic Supports, A. Y. Arinbasarova, A. A. Artemova, A. V. Kiselev, K. A. Koshcheenko, and S. Y. Nikitin, *Prikl. Biokhim. Mikroorg.* **18**, 331–338 (1982).
6. Immobilization of Yeast Cells Containing beta-Galactosidase, M. Banerjee, A. Chakrabarty, and S. K. Majumdar, *Biotechnol. Bioeng.* **24**, 1839–1850 (1982).
7. Continuous Production of L-Tryptophan from Indole and L-Serine by Immobilized *Escherichia coli* Cells, W-G Bang, U. Behrendt, S. Lang, and F. Wagner, *Biotechnol. Bioeng.* **25**, 1013–1026 (1983).
8. Glycerol Production by Immobilized Cells of *Saccharomyces cerevisiae*, B. Bisping and H. J. Rehm, *Eur. J. Appl. Microbiol. Biotechnol.* **14**, 136–139 (1982).
9. Carbohydrate-Specific Cell Adhesion is Mediated by Immobilized Glycolipids, C. C. Blackburn and R. L. Schnaar, *J. Biol. Chem.* **258**, 1180–1188 (1983).
10. Semicontinuous Cultivation of Hydrolase-Producing Fungi of the Genus *Aspergillus* R. K. Blicva, *Mikrobiologiya* **51**, 945–949 (1982).
11. Immobilized Plant Cells, P. Brodelius, and K. Mosbach, *Adv. Appl. Microbiol.* **28**, 1–26 (1982).
12. Immobilization and Stabilization of Green and Blue Green Algae in Crosslinked Serum Albumin Glutaraldehyde and in Polyurethane Matrices, M. Brouers, F. Collard, J. Jeanfils, and A. Jeanson, *Sol. Energy R&D Eur. Community, Ser. D* **1**, 134–139 (1982).
13. Reaction Engineering Parameters for Immobilized Biocatalysts, K. Buchholz, *Adv. Biochem. Eng.* **24**, 39–71 (1982).
14. Alcohol Production with a Plug Flow Reactor Containing Immobilized Bacteria, R. A. Clyde, *Energy Biomass Wastes* **6**, 887–896 (1982).
15. Methanol Bioconversion by *Butyribacterium methylotrophicum*-Batch Fermentation Yield and Kinetics, R., Datta and J. Ogletrec, *Biotechnol. Bioeng.* **25**, 991–998 (1983).
16. Ethylene Oxide Production by Immobilized *Mycobacterium Pyl* in a Gas-Solid Bioreactor, J. A. M. de Bont, C. G. van Ginkel, J. Tramper, and K. Ch. A. M. Luyben, *Enzyme Microb. Technol.* **5**, 55–59 (1983).
17. Semi-Continuous Production of the Antibiotic Patulin by Immobilized Cells of *Penicillium urticae*, Y. M. Deo and G. M. Gaucher, *Biotechnol. Lett.* **5**, 125–130 (1983).
18. A Biotechnological Approach to the Synthesis of Epoxides: Bioconversion of Hydrocarbons by *Pseudomonas oleovorans* During Growth in a Multiphase System M. J. De Smet, *Biotechnol. Bioeng.* **25**, 1161–1162 (1983).
19. Immobilization of Yeasts on Titanium Activated Inorganic Supports, S. M. Dias, J. M. Novais, and J. M. S. Cabral, *Biotechnol. Lett.* **4**, 203–208 (1982).
20. High-Temperature Immobilized-Cell Ultrafiltration Reactors, E. Driolo, G. Iorio, M. De Rosa, A. Gambacorta, and B. Nicolaus, *J. Membr. Sci.* **11**, 365–370 (1982).
21. Enhanced Stability of Enzymes in Permeabilized and Immobilized Cells, H. R. Felix and K. Mosbach, *Biotechnol. Lett.* **4**, 181–186 (1982).
22. Microbial Enhancement of Oil Recovery, W. R. Finnerty and M. E. Singer, *Biotechnol.* **1**, 47–54 (1983).

23. Protein Determination of Cells Immobilized in Crosslinked Synthetic Gels, A. Freeman, T. Blank, and Y. Aharonowitz, *Eur. J. Appl. Microbiol. Biotechnol.* **14**, 13–15 (1982).
24. Cellulase-Production by *Trichoderma reesei* Immobilized on kappa-Carrageenan, E. M. Frein, B. S. Montenecourt, and D. E. Eveleigh, *Biotechnol. Lett.* **4**, 287–292 (1982).
25. Confining Mycelial Growth to Porous Microbeads. A Novel Technique to Alter the Morphology of Non-Newtonian Mycelial Cultures, K. Gbewonyo and D. I. C. Wang, *Biotechnol. Bioeng.* **25**, 967–984 (1983).
26. Reduction of Limonin Bitterness in Navel Orange Juice Serum with Bacterial Cells Immobilized in Acrylamide Gel, S. Hasegawa, M. N. Patel, and R. C. Snyder, *J. Agric. Food Chem.* **30**, 509–511 (1982).
27. Oxygenation of Immobilized Cells Using Hydrogen Peroxide; a Model Study of *Gluconobacter oxydans* Converting Glycerol to Dihydroxyacetone, O. Holst, S. O. Enfors, and B. Mattiasson, *Euro. J. Appl. Microbiol. Biotechnol.* **14**, 64–68 (1982).
28. Immobilization of *Clostridium thermocellum* Cells on bituminous Coal Particles, P. N. Horne and H. W. Hsu, *Anal. Bioch.* **129**, 72–79 (1983).
29. Preparation and Performance of Immobilized Yeast Cells in Columns Containing No Inert Carrier, H. Y. Hsiao, L. C. Chiang, C. M. Yang, L. F. Chen, and G. T. Tsao, *Biotechnol. Bioeng.* **25**, 363–375 (1983).
30. Extraction of Nucleotides and Their Derivatives from Immobilized *Propionibacterium Shermanii*, N. P. Ikonnikov, E. P. Jordan, and L. I. Vorb'eva, *Prikl. Biokhim. Mikrobiol.* **18**, 34–40 (1982).
31. Fructose as a Carbohydrate Source Yields Stable pH and Redox Parameters in Microcarrier Cell Culture, T. Imamura, C. L. Crespi, W. G. Thilly, and H. Brunengraber, *Anal. Biochem.* **124**, 353–358 (1982).
32. Porous Kaolin Bead: A Novel but Economical Support Material for Fluidized Bed Technology, H-R. Jian, X. Zhang, X-H. Lo, S-P. Zhou, X-W. Cai, and W-W. Tso, *Biotechnol. Lett.* **5**, 85–88 (1983).
33. Immobilization of *Mortierella vinacea* Cells by Radiation Polymerization, M. Kumakura and I. Kaetsu, *J. Appl. Polym. Sci.* **28**, 295–301 (1983).
34. Hydrogen Production from Glucose by Immobilized Growing Cells of *Clostridium butyricum*, I. Karube, N. Urano, T. Matsunaga, and S. Shuichi, *Eur. J. Appl. Microbiol. Biotechnol.* **16**, 5–9 (1982).
35. Correlation of Experimental and Theoretical Data for Artificial and Natural Systems with Immobilized Biocatalysts, V. Kasche, *Enzyme Microb. Technol.* **5**, 2–13 (1983).
36. Accumulation of Heavy Metals in Unicellular Algae, D. Khummongkol, G. S. Canterford, and C. Fryer, *Biotechnol. Bioeng.* **24**, 2643–2660 (1982).
37. Immobilization of Living Whole Cells in an Epoxy Matrix, J. Klein and B. Kressdorf, *Biotechnol. Lett.* **4**, 375–380 (1982).
38. Immobilized Cells: Catalyst Preparation and Reaction Performance, J. Klein and K. D. Vorlop, *ACS Symp. Ser.* **207**, 377–392 (1983).
39. Immobilization of *Nitrosomonas europaea* Cells with Polyelectrolyte Complex, E. Kokufuta, W. Matsumoto, and I. Nakamura, *Biotechnol. Bioeng.* **24**, 1591–1603 (1982).
40. Immobilization of Living Microbial Cells and Their Application for Steroid Transformations, K. A. Koshcheyenko, M. V. Turkina, and G. K. Skryabin, *Enzyme Microb. Technol.* **5**, 14–21 (1983).

41. Continuous Isopropanol-Butanol-Ethanol Fermentation by Immobilized *Clostridium beijerinckii* Cells in a Packed Bed Fermenter, P. G. Krouwel, W. J. Groot, N. W. F. Kossen, and W. F. M. van der Laan, *Enzyme Microb. Technol.* **5**, 46–54 (1983).
42. Two-Liquid Phase Biocatalytic Reactors, M. D. Lilly, *Philos. Trans. R. Soc. London* **300**, 391–398 (1983).
43. Ethanol Production from D-Galactose and Glycerol by *Pachysolen tannophilus*, R. Maleszka, P. Y. Wang, and H. Schneider, *Enzyme Microb. Technol.* **4**, 349–352 (1982).
44. Immobilized Microbes and a High-Rate, Continuous, Anaerobic Waste Processor, R. A. Messing, *Energy Biomass Wastes* **6**, 425–442 (1982).
45. Degradation of Caffeine by Immobilized Cells of *Pseudomonas putida* strain C 3024, W. J. Middelhoven and C. M. Bakker, *Eur. J. Appl. Microbiol. Biotechnol.* **15**, 214–217 (1982).
46. The Potential in Biotechnology of Immobilized Cells and of Immobilized Multistep Enzyme-Coenzyme Systems, K. Mosbach, *Philos. Trans. R. Soc. London* **300**, 355–367 (1983).
47. Recover of uranium by Immobilized Microorganisms, A. Nakajima, T. Horikoshi, and T. Sakaguchi, *Eur. J. Appl. Microbiol. Biotechnol.* **16**, 88–91 (1982).
48. Columnar Denitrification of Water by Immobilized *Pseudomonas denitrificans* Cells, I. Nilsson and S. Ohlson, *Eur. J. Appl. Microbiol. Biotechnol.* **14**, 86–90 (1982).
49. Production of Protease Inhibitors by the Washed-Cell System of Immobilized-Cell System of *Streptomyces libani*, S. Oka and H. Suzuki, *Kenkyu Hokoku-Kogyo Gijutsuin Biseibutsu Kogyo Gijutsu Kenkyusho* **58**, 17–23 (1982).
50. Bioconversion of Acrylonitrile to Acrylamide by Immobilized Cells, S. Papaconstantinou, A. Grasmick, M. C. Habig, S. Elmaleh, and R. Ben Aim, *Entropie* **18**, 10–14 (1982).
51. Factors Affecting Cell Attachment, Spreading, and Growth on Derivatized Microcarriers. I. Establishment of Working System and Effect of the Type of the Amino-Charged Groups, S. Reuveny, A. Mizrahi, M. Kotler, and A. Freeman, *Biotechnol. Bioeng.* **25**, 469–480 (1983).
52. Continuous Ethanol Production by Yeast Cells Immobilized in Open Pore Gelatin Matrix, H. SivaRaman, B. S. Rao, A. V. Pundle, and C. SivaRama, *Biotechnol. Lett.* **4**, 359–364 (1982).
53. Alpha-Hydroxylation of Progesterone by Gel-Entrapped Living *Rhizopus stolonifer* Mycelia, K. Sonomoto, K. Nomura, A. Tanaka, and S. Fukui, *Eur. J. Appl. Microbiol. Biotechnol.* **16**, 57–62 (1982).
54. Production of L-Lactic Acid with Immobilized *Lactobacillus delbrueckii*, S. L. Stenroos, Y. Y. Linko, and P. Linko, *Biotechnol. Lett.* **4**, 159–164 (1982).
55. Production of L-Alanine from Ammonium Fumarate Using Two Immobilized Microorganisms, S. Takamatsu, I. Umemura, K. Yamamoto, T. Sato, T. Tosa, and I. Chibata, *Euro. J. Appl. Microbiol. Biotechnol.* **15**, 147–152 (1982).
56. Performance of an Anaerobic Filter for Purification and Methane Production from Waste Water of a Sugar Refinery, W. Tesch, K. Schneider, and R. Bachofen, *Process Biochem.* **18**, 34–37 (1983).
57. Microcarriers and the Problem of High-Density Cell Culture, W. G. Thilly, D. Barngrover, and J. N. Thomas, *Miami Winter Symp.* **19**, 75–103 (1982).
58. Zeta Potential of yeast Cells: Application in Cell Immobilization, Ph. Thonart, M. Custinne, and M. Paquot, *Enzyme Microb. Technol.* **4**, 191–194 (1982).

59. Lactic Acid Production by a new *Lactobacillus* sp., *Lactobacillus vaccinostercus* Kozaki and Okada sp. nov., Immobilized in Calcium Alginate, P. Tipayang and M. Kozaki, *J. Ferment. Technol.* **60**, 595–598 (1982).
60. Production of Tylosin and Nikkomycin by Immobilized *Streptomyces* Cells, M. Veelken and H. Pape, *Eur. J. Appl. Microbiol. Biotechnol.* **15**, 206–210 (1982).
61. Hydrogen Production by Immobilized Cells. II. Hydrogen Photoevolution and Wastewater Treatment by Agar-Entrapped Cells of *Rhodopseudomonas palustris* and *Rhodospirillum molischianum*, M. Vincenzini, R. Materassi, M. R. Tredici, and G. Florenzano, *Int. J. Hydrogen Energy* **7**, 725–728 (1982).
62. Continuous Denitrification by Immobilized Cells, M. Vossoughi, M. Laroche, J. M. Navarro, G. Faup, and A. Leprince, *Water Res.* **16**, 995–1002 (1982).
63. Cell Immobilization in kappa-Carrageenan with Tricalcium Phosphate, H. Y. Wang and D. J. Hettwer, **24**, 1827–1838 (1982).
64. Maximizing Microbial Cell Loading in Immobilized Cell Systems, H. Y. Wang, S. S. Lee, Y. Takach, and L. Cawthon, *Biotechnol. Bioeng. Symp.* **12**, 139–146 (1982).
65. Temperature Effects During Polymerization of Polyacrylamide Gels Used for Bacterial Cell Immobilization, M. A. Wheatley and C. R. Phillips, *Biotechnol. Bioeng.* **25**, 623–626 (1983).
66. Immobilized Microorganisms in Wastewater Treatment, T. Winnicki, R. Szetela, and J. Wisniewski, *Stud. Environ. Sci.* **19**, 341–352 (1982).
67. The Minimum-Sized Ideal Reactor for Continuous Alcohol Fermentation Using Immobilized Microorganisms, T. Yamane and S. Shimizu, *Biotechnol. Bioeng.* **24**, 2731–2737 (1982).
68. Formation of α , ω -Dodecanedioic Acid and α , ω -Tridecanedioic Acid from Different Substrates by Immobilized Cells of a Mutant of *Candida tropicalis*, Z-H. Yi and H. J. Rehm, *Eur. J. Appl. Microbiol. Biotechnol.* **16**, 1–4 (1982).
69. Production of Adenine Arabinoside by Gel-Entrapped Cells of *Enterobacter aerogenes* in Water-Organic Cosolvent System, K. Yokozeki, S. Yamanaka, T. Utagawa, K. Takinami, Y. Hirose, A. Tanaka, K. Sonomoto, and S. Fukui, *Eur. J. Appl. Microbiol. Biotechnol.* **14**, 225–231 (1982).
70. Production of Vitamin B₁₂ by Immobilized Cells of a Propionic Acid Bacterium, B. Yongsmith, K. Sonomoto, A. Tanaka, and S. Fukui, *Eur. J. Appl. Microbiol. Biotechnol.* **16**, 70–74 (1982).
71. *Bacillus thuringiensis*-an Insecticidal Micro-organism with Perspective, B. Zamola, P. Valles, A. Saric, M. Kubovic, C. Sider, and P. Miccoli, *Process Biochem.* **18**, 5–9 (1983).