



REFERENCES

- Abramowicz, D. A., and Keese, C. R. (1989). Enzymatic transesterifications of carbonates in water-restricted environments. Biotechnology and Bioengineering, 33, 149-156.
- Aizono, Y., Funatsu, M., Fukiji, Y., and Watanabe, M. (1976). Purification and characterization of rice bran lipase II. Agricultural and Biological Chemistry, 40(2), 317-324.
- Aizono, Y., Funatsu, M., Sugano, M., Hayashi, K., and Fujiki, Y. (1973). Enzymatic properties of rice bran lipase. Agricultural and Biological Chemistry, 37(9), 2031-2036.
- Ajima, A., Yoshimoto, T., Takahashi, K., Tamaura, Y., Saito, Y., and Inada Y. (1985). Polymerization of 10-hydroxydecanoic acid in benzene with polyethylene glycol-modified lipase. Biotechnology Letters, 7 (5), 303-306.
- Arroyo, M., Sanches-Montero, J. M., and Sinisterra, J. V. (1999). Thermal stabilization of immobilized lipase B from *Candida antarctica* on different supports: Effect of water activity on enzymatic activity in organic media. Enzyme and Microbial Technology, 24, 3-12.
- Basheer, S., Nakajima, M., and Cogan, U. (1996). Sugar ester-modified lipase for the esterification of fatty acids and long chain alcohols. Journal of the American Oil Chemists Society, 73(11), 1475-1479.
- Berkane, C., Mezoul, G., Lalot, T., Brigodiot, M., and Marechal, E. (1997). Lipase-catalyzed polyester synthesis in organic medium. Study of ring-chain equilibrium. Macromolecules, 30, 7729-7734.
- Bisht, S. K., Henderson, L. A., Gross, R. A., Kaplan, D. L., and Swift, G. (1997). Enzyme-catalyzed ring-opening polymerization of ω -pentadecalactone. Macromolecules, 30, 2705-2711.

- Bisht, S. K., Svirkin, Y. Y., Henderson, L. A., and Gross, R. A. (1997). Lipase-catalyzed ring-opening of trimethylene carbonate. Macromolecules, 30, 7735-7742.
- Bosley, J. A. (1997). Turning lipases into industrial biocatalysts. Biochemical Society Transactions, 25, 174-178.
- Bosley, J. A., and Peilow, D. A. (1997). Immobilization of lipases on porous polypropylene: Reduction in esterification efficiency at low loading. Journal of the American Oil Chemists Society, 74(2), 107-111.
- Brady, C., Metcalfe, L., Slabozewski, D., and Frank, D. (1988). Lipase immobilization on a hydrophobic, microporous support for the hydrolysis of fats. Journal of the American Oil Chemists Society, 65 (6), 917-921.
- Brazwell, E. M., Filos, D. Y., and Morrow, C. J. (1995). Biocatalytic synthesis of polymer. III. Formation of a high molecular weight polyester through limitation of hydrolysis by enzyme-bound water and through equilibrium control. Journal of Polymer Science: Part A: Polymer Chemistry, 33, 89-95.
- Cao, L., Bornscheuer, U. T., and Schmid, R. D. (1999). Lipase-catalysed solid-phase synthesis of sugar esters. Influence of immobilization on productivity and stability of the enzyme. Journal of Molecular Catalysis B: Enzymatic, 6, 279-285.
- Carta, G., Gainer, J. L., and Benton, A. H. (1990). Enzymatic synthesis of esters using an immobilized lipase. Biotechnology and Bioengineering, 37, 1004-1009.
- Chaudhary, A. K., Lopez, J., Beckman, E. J., and Russell, A. J. (1997). Biocatalytic solvent-free polymerization to produce high molecular weight polyesters. Biotechnology Progress, 13, 318-325.
- Chaudhary, A. K., Beckman, E. J., and Russell, A. J. (1997, July). Biocatalytic polyester synthesis: Analysis of the evolution of

- molecular weight and end group functionally. Biotechnology and Bioengineering, 55(1), 227-239.
- Cho, S-W., and Rhee, J. S. (1993). Immobilization of lipase for effective interesterification of fats and oils in organic solvent. Biotechnology and Bioengineering, 41, 204-210.
- Deetz, J. S., and Rozzell, J. D. (1988, January). Enzyme-catalysed reactions in non-aqueous medias. Trends in Biotechnology, 6, 15-19.
- Fadnavis, N. W., and Jadhav, V. (1997). Enantioselective hydrolytic reactions of rice bran lipase (RBL): a first report. Tetrahedron: Asymmetry, 8(14), 2361-2366.
- Fujiki, Y., Aizono, Y., and Funatsu, M. (1978). Characterization of minor subunit of rice bran lipase. Agricultural and Biological Chemistry, 42 (12), 2401-2402.
- Funatsu, M., Aizono, Y., Hayashi, K., Watana, M., and Eto, M. (1971). Biochemical studies on rice bran lipase: Part I. Purification and physical properties. Agricultural and Biological Chemistry, 35(5), 734-742.
- Gray, C. J., Narang, J. S., and Barker, S. A. (1990). Immobilization of lipase from *Candida cylindraceae* and its use in the synthesis of menthol esters by transesterification. Enzyme and Microbial Technology, 12, 800-807.
- Geresh, S., and Gilboa, Y. (1990, July). Enzymatic synthesis of alkyds. Biotechnology and Bioengineering, 36, 270-274.
- Gutman, A. L., Oren, D., Boltanski, A., and Bravdo, T. (1987). Enzymatic oligomerisation versus lactonisation of ω -hydroxyesters. Tetrahedron Letters, 28(44), 5367-5368.
- Halling, P. J. (1984). Effects of water on equilibria catalysed by hydrolytic enzyme in biphasic reaction systems. Enzyme and Microbial Technology, 6, 513-516.

- Hernaiz, M. J., Sanchez-Montero, and Sinisterra, J. V. (1999). Modification of purified lipases from *Candida rugosa* with polyethylene glycol: A systematic study. Enzyme and Microbial Technology, 24, 181-190.
- Ison, A. P., Dunnill, P., and Lilly, M. D. (1988). Effect of solvent concentration on enzyme catalysed interesterification of fats. Enzyme and Microbial Technology, 10, 57-51.
- Ivanov, A. V., and Schneider, M. P. (1997). Methods for the immobilization of lipases and their use of ester synthesis. Journal of Molecular Catalysis B: Enzymatic, 3, 303-309.
- Jasskelainen, S., Linko, S., Raaska, T., Laaksonen, L., and Linko, Y. Y. (1997). Molecular modelling of lipase-catalyzed polyester synthesis. Journal of Biotechnology, 52, 267-275.
- Karlsson, S., Backlund, S., Eriksson, F., and Hedstrom, G. (1998). Enzymatic esterifications and transesterifications in AOT-based gels with different composition. Colloids and Surfaces B: Biointerfaces, 10, 137-147.
- Kaschre, V. (1986). Mechanism and yields in enzyme catalysed equilibrium and kinetically controlled synthesis of β -lactum antibiotics, peptides and other condensation products. Enzyme and Microbial Technology, 8, 4-16.
- Kobayashi, S., Uyama, H., Namekawa, S., and Hayakawa, H. (1998). Enzymatic ring-opening polymerization and copolymerization of 8-octanolide by lipase catalyst. Macromolecules, 31, 5655-5659.
- Langrand, G., Baratti, J., Buono, G., and Triantaphylides, C. (1986). Lipase catalyzed reactions and strategy for alcohol resolution. Tetrahedron Letters, 27(1), 29-32.
- Lee, K. T., and Akoh, C. C. (1997). Effect of selected substrate forms on the synthesis of structured lipids by two immobilized lipases. Journal of the American Oil Chemists Society, 5, 579-584.

- Linko, Y. Y., Wang, Z. L., and Seppala, J. (1995). Lipase-catalyzed linear aliphatic polyester synthesis in organic solvent. Enzyme and Microbial Technology, 17, 506-511.
- Longo, M. A., and Combes, D. (1999). Thermostability of modified enzymes: a detailed study. Journal of Chemical Technology and Biotechnology, 74, 25-32.
- Lortie, R. (1997). Enzyme catalyzed esterification. Biotechnology Advances, 15(1), 1-15.
- Lye, G. J., Pavlou, O. P., Rosjidi, M., and Stuckey, D. C. (1996). Immobilization of *Candida cylindraceae* lipase on colloidal liquid aphrons (CLAs) and development of a continuous CLA-membrane reactor. Biotechnology and Bioengineering, 51, 69-78.
- MacDonald, R. T., Pulapura, S. K., Svirkin, Y. Y., and Gross, R. A. (1995). Enzyme-catalyzed ϵ -caprolactone ring-opening polymerization. Macromolecules, 28, 73-78.
- Margolin, A. L., Crenne, J. Y., and Klibanov, A. M. (1987). Stereoselective oligomerizations catalyzed by lipases in organic solvents. Tetrahedron Letters, 28(15), 1607-1610.
- McNeill, G. P., Ackman, R. G., and Moore, S. R. (1996). Lipase-catalyzed enrichment of long-chain polyunsaturated fatty acids. Journal of the American Oil Chemists Society, 73(11), 1403-1407.
- Mezoul, G., Lalot, T., Brigodiot, M., and Marechal, E. (1995). Enzyme-catalyzed synthesis of aliphatic polyesters in organic media: Study of transesterification equilibrium shift and characterization of cyclic compounds. Journal of Polymer Science: Part A: Polymer Chemistry, 33, 2691-2698.
- Miller, C., Austin, H., Posorske, L., and Gonzalez, J. (1988). Characteristics of an immobilized lipase for the commercial synthesis of esters. Journal of the American Oil Chemists Society, 65(6), 927-931.

- Minoru, N., Machida, T., Sakai, W., and Naoto, T. (1998). Synthesis, characterization, and enzymatic degradation studies on novel network aliphatic polyesters. Macromolecules, 31, 6450-6454.
- Montero, S., Blanco, A., Virto, M.D., Landeta, L. C., Agud, I., Solozabal, R., Las caray, J. M., Renobales, M. D., Llama, M. J., and Serra, J. L. (1993). Immobilization of *Candida rugosa* lipase and some properties of the immobilized enzyme. Enzyme Microbial Technology, 15, 239-247.
- Mustranta, A., Forssell, P., and Poutanen, K. (1993). Applications of immobilized lipases to transesterification and esterification reactions in nonaqueous systems. Enzyme Microbial Technology, 15, 133-139.
- Nagata, M., Ibuki, H., Sakai, W., and Tsutsumi, N. (1997). Synthesis, characterization, and enzymatic degradation of novel regular network aliphatic polyesters based on pentaerythritol. Macromolecules, 30, 6525-6530.
- Nobes, G. A. R., Kazlauskas, R. J., and Marchessault, R. H. (1996). Lipase-catalyzed ring opening polymerization of lactones: A novel route to poly(hydroxyalkanoate)s. Macromolecules, 29, 4829-4883.
- Pencreach, G., Leullier, M., and Baratti, J. C. (1997). Properties of free and immobilized lipase from *Pseudomonas cepacia*. Biotechnology and Bioengineering, 52(2), 181-189.
- Reetz, M., Zonta, A., and Simpelkamp, J. (1996). Efficient immobilization of lipase by entrapment in hydrophobic sol-gel materials. Biotechnology and Bioengineering, 49, 527-534.
- Reshe, H., and Ritter, H. (1989). Enzyme in polymer chemistry: lipase-catalyzed acetylation of methacrylic polymers containing OH groups. Polymer Bulletin, 21, 535-540.

- Rice, K. E., Watkins, J., and Hill, C. G. (1999). Hydrolysis of menhaden oil by a *Candida cylindraceae* lipase immobilized in a hollow-fiber reactor. . Biotechnology and Bioengineering, 63(1), 33-45.
- Ruckenstein, E., and Wang, X. (1993). Lipase immobilized on hydrophobic porous polymer supports prepared by concentrated emulsion polymerization and their activity in the hydrolysis of triglycerides. Biotechnology and Bioengineering, 42, 821-828.
- Seppala, J., and Linko, Y. Y. (1996, August). Producing high molecular weight biodegradable polyesters. Chemtech, 8, 25-31.
- Shastry, B. S., and Raghavendra Rao, M. R. (1976). Chemical studies on rice bran lipase. American Association of Cereal Chemists, 53, 190-200.
- Shaw, J-F., and Chang, R-C. (1990). Lipolytic activities of lipase immobilized on six selected supporting materials. Biotechnology and Bioengineering, 35, 132-137.
- Stark, M-B., and Holmberg, K. (1989). Covalent immobilization of lipase in organic solvents. Biotechnology and Bioengineering, 34, 942-950.
- Svirkin, Y. Y., Xu, J., and Gross, R. A. (1996). Enzyme-catalyzed stereoselective ring opening polymerization of α -methyl- β -propiolactone. Macromolecules, 29, 4591-4597.
- Tsai, S. W., and Dordick, J. S. (1996). Extraordinary enantiospecificity of lipase catalysts in organic media induced by purification and catalyst engineering. Biotechnology and Bioengineering, 52, 296-300.
- Uyama, H., Takeya, K., Hoshi, N., and Kobayashi, S. (1995). Lipase-catalyzed ring opening polymerization of 12-dodecanolide. Macromolecules, 28, 7406-7050.
- Wallace, J. S., and Morrow, C. J. (1989). Biocatalytic synthesis of polymers. II. Preparation of [AA-BB]_x polyesters by porcine pancreatic lipase catalyzed transesterification in anhydrous, low polarity organic

- solvents. Journal of Polymer Science: Part A: Polymer Chemistry, 27, 3271-3284.
- Wang, Z. L., Linko, Y. Y., and Seppala, J. (1995). Lipase-catalyzed polyesterification in an organic solvent. Biotechnology Techniques, 9 (5), 349-354.
- Wei, Z. G., and Sih, C. J. (1988). Enzymatic synthesis of macrocyclic lactones. Journal of American Chemical Society, 110, 1999-2001.
- Wu, X. Z., Seppala, J., Linko, Y. Y. (1996). Lipase-catalyzed polyester synthesis. Biotechnology Techniques, 10(10), 793-798.
- Xu, J., Gross, R. A., Kaplan, D. L., and Swift, G. (1996). Chemoenzymatic synthesis and study of poly(α -methyl- β -propiolactone) stereocopolymers. Macromolecules, 29, 4582-4590.
- Yokoyama, M., Miyamoto, M., and Hirano, K. (1981). Purification and properties of acid ribonuclease in rice bran. Agricultural and Biological Chemistry, 46(1), 247-253.
- Zaks, A., and Klivanov, A. M. (1984, June). Enzymatic catalysis in organic media at 100°C. Science, 224, 1249-1251.



CURRICULUM VITAE

Name: Nonsee Nimitsiriwat

Date: 15 August 1976

Nationality: Thai

University Education:

Bachelor Degree of Chemistry,
Chiang Mai University