

## REFERENCES

### Thai

- จุฬาลงกรณ์มหาวิทยาลัย, คณะเภสัชศาสตร์, ภาควิชาเภสัชพฤกษศาสตร์, 2530. ชื่อสมุนไพรและ  
ประโยชน์. กรุงเทพมหานคร : ภาควิชาเภสัชพฤกษศาสตร์ คณะเภสัชศาสตร์  
จุฬาลงกรณ์มหาวิทยาลัย
- นันทวัน บุญยะประภัศร, บรรณาธิการ. 2532. เปล้าน้อย. จุลสารโครงการศูนย์ข้อมูลสมุนไพร,  
มหาวิทยาลัยมหิดล. 6: 1-6.
- ประเสริฐ พรหมมณี และคณะ. 2531. ตำราเภสัชกรรมไทยแผนโบราณ. กรุงเทพมหานคร : โรง  
พิมพ์จุฬาลงกรณ์มหาวิทยาลัย.
- เปรมจิต นาคประสิทธิ์, บรรณาธิการ. 2526. เปล้าน้อย. ข่าวสารเภสัชพาณิชย์ : 34: 4.  
มหิดล, มหาวิทยาลัย คณะเภสัชศาสตร์. 2523. สมุนไพรสวนสิริรุกษชาติ. กรุงเทพมหานคร : คณะ  
เภสัชศาสตร์ มหาวิทยาลัยมหิดล.

### English

- Airy Shaw, H.K., 1972. The Euphorbiaceae of Siam. Hong Kong : Kew Bull.  
pp191-363.
- Back, K., and Chappell, J. 1995. Cloning and bacterial expression of a sesquiterpene  
cyclase from *Hyoscyamus muticus* and its molecular comparison to related  
terpene cyclases. J Biol Chem. 270: 7375-7381.
- Bansal, V.S., and Vaidya, S. 1994. Characterization of two distinct allyl  
pyrophosphatase activities from rat liver microsomes. Arch Biochem  
Biophys. 315: 393-399.
- Banthorpe, D.V., Brown, J.T., and Morris, G.S. 1992. Partial purification of farnesyl  
pyrophosphate: drimenol cyclase and geranylgeranyl pyrophosphate:

- sclareol cyclase, using cell culture as a source of material. Phytochemistry 31: 3391-3395.
- Beyer, P., Klaus, K., and Kleinig, H. 1985. Separation of mevalonate phosphates and isopentenyl pyrophosphate by thin-layer chromatography and of short-chain prenyl phosphates by ion-pair chromatography on a high-performance liquid chromatography column. Methods Enzymol. 111B: 248-52.
- Bohlmann, J., Martin, D., Oldham, N. J., and Gershenzon, J. 2000. Terpenoid secondary metabolism in *Arabidopsis thaliana*: cDNA cloning, characterization, and functional expression of a myrcene/(*E*)- $\beta$ -ocimene synthase. Arch Biochem Biophys. 375: 261-269.
- Bouwmeester, H.J., Wallaart, T.E., Janssen, M.H., van Loo, B., Jansen, B.J., Posthumus, M.A., Schmidt, C.O., De Kraker, J.W., Konig, W.A., and Franssen, M.C. 1999. Amorpha-4,11-diene synthase catalyses the first probable step in artemisinin biosynthesis. Phytochemistry 52: 843-854.
- Bourgaud, F., Gravot, A., Milesi, S., and Gontier, E. 2001. Review: Production of plant secondary metabolites: a historical perspective. Plant Sci. 161: 839-851.
- Bouzbouz, S., and Kirschleger, B. 1994. Synthesis of pure *trans, trans, trans*-geranylgeraniol. Synlett. 9: 763-764.
- Boyer, S. H. 1961. Alkaline phosphatase in human sera and placenta. Science 1002-1004.
- Bradford, M.M. 1976. A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. Anal Biochem. 72: 248-254.
- Broun, P., and Someville, C. 2001. Progress in plant metabolic engineering. Proc Natl Acad Sci U S A. 98: 8925-8927.
- Buchanan, B.B., Gruissen, W., and Jones, R.L. 2000. Biochemistry and molecular biology of plants. Library of Congress Cataloging-in-Publication data: USA pp. 160-201.
- Burger, A.B., Zhang, K.H., Granger, S.P., Rawlings, A.V., and Scott, I.R. 1998. Skin care composition containing geranylgeraniol and retinol or retinyl esters. United States Patent 5,756,109. May 26.

- Chen, D., Ye, H.C., and Li, G.F. 2000. Expression of chimeric farnesyl diphosphate synthase gene in *Artemisia annua* L. transgenic plants via *Agrobacterium tumefaciens* mediated transformation. Plant Sci. 155 : 179-185.
- Chotani, G., Dodge, T., Hsu, A., Kumar, M., LaDuca, R., Trimbur, D., Weyler, W., and Sanford, K. 2000. Review: The commercial production of chemicals using pathway engineering. Biochim Biophys Acta. 1543: 434-455.
- Christopher, M.H., and Poulter, C.D. 2000. Recent studies of the mechanism of protein prenylation. Nat Prod Rep. 17: 137-144.
- Croteau, R., and Karp, F. 1979a. Biosynthesis of monoterpenes: preliminary characterization of bornyl pyrophosphate synthetase from sage (*Salvia officinalis*) and demonstration that geranyl pyrophosphate is the preferred substrate for cyclization. Arch Biochem Biophys. 198: 512-522.
- Croteau, R., and Karp, F. 1979b. Biosynthesis of monoterpenes: Hydrolysis of bornyl pyrophosphate, an essential step in camphor biosynthesis, and hydrolysis of geranyl pyrophosphate, the acyclic precursor of camphor, by enzymes from sage (*Salvia officinalis*). Arch Biochem Biophys. 198: 523-532.
- Davisson, V.J., Woodside, A.B., and Poulter, C.D. 1985. Synthesis of allylic and homoallylic isoprenoid pyrophosphates. Methods Enzymol. 110: 130-144.
- Davisson, V.J., Woodside, A.B., Neal, T.R., Stremler, K.E., Muehlbacher, M., and Poulter, C.D. 1986. Phosphorylation of isoprenoid alcohols. J Org Chem. 51: 4768-4779.
- De-Eknamkul, W., and Potduang, B. 2003. Biosynthesis of  $\beta$ -sitosterol and stigmasterol in *Croton sublyratus* proceeds via a mixed origin of isoprene. Phytochemistry. 62: 389-398.
- De-Eknamkul, W., and Tansakul, P. Geranylgeraniol-18-hydroxylase from *Croton sublyratus*. United States Patent 5,879,916.
- Emanuelsson, O., Nielsen, H., Brunak, S., and von Heijne, G. 2000. Predicting subcellular localization of proteins based on their N-terminal amino acid sequence. J Mol Biol. 300: 1005-1016.
- Emanuelsson, O., Nielsen, H., and von Heijne, G. 2000. ChloroP, a neural network-based method for predicting chloroplast transit peptides and their cleavage sites. Protein Sci. 8: 978-984, 1999.

- Engprasert, S., Taura, F., Kawamukai, M., and Shoyama, Y. 2004. Molecular cloning and functional expression of geranylgeranyl pyrophosphate synthase from *Coleus forskohlii* Briq. BMC Plant Biol. 4: 18
- Esser, H. and Chayamarit, K. 2001. Two new species and a new name in Thai *Croton* (Euphorbiaceae). Thai For. Bull. (Bot). 29: 51-57.
- Faulkner, A., Chen, X., Rush, J., Horazdovsky, B., Waechter, C.J., Carman, G.M., and Sternweis, P.C. 1999. The *LPP1* and *DPP1* gene products account for most of the isoprenoid phosphate phosphatase activities in *Saccharomyces cerevisiae*. J Biol Chem. 274: 14831-14837.
- Fischbach, R.J., Zimmer, W., and Schnitzler, J.P. 2001. Isolation and functional analysis of a cDNA encoding a myrcene synthase from holm oak (*Quercus ilex* L.). Eur J Biochem. 268: 5633-5638.
- Flora of Thailand. Available from <http://www.nationalherbarium.n/thaieuph/ThSearchUse.htm> [2003, July 23].
- Frank, D.W., and Waechter, C.J. 1998. Purification and characterization of a polyisoprenyl phosphate phosphatase from pig brain. J Biol Chem. 273: 11791-11798.
- Heijne, G., Steppuhn, J., and Herrmann, R.G. 1989. Domain structure of mitochondrial and chloroplast targeting peptides. J Biochem. 180: 535-545.
- Hirokawa, T., Boon-Chieng, S., and Mitaku, S. 1998. SOSUI: Classification and secondary structure prediction system for membrane proteins, Bioinformatics 14: 378-379.
- Gafni, Y., and Shechter, I. 1979. An efficient method for the synthesis and purification of *trans*-[<sup>14</sup>C] geranylgeranyl pyrophosphate. Anal Biochem. 92: 248-252.
- Gavel, Y., and von Heijne, G. 1990. Sequence differences between glycosylated and non-glycosylated Asn-X-Thr/Ser acceptor sites. Protein Engineering 3: 433-442.
- Goldman, R., and Strominger, J.L. 1972. Purification and properties of C55-isoprenylpyrophosphate phosphatase from *Micrococcus lysodeikticus*. J Biol Chem. 247: 5116-5122.

- Huang, K., Huang, Q., Scott, A.I. 1998. Overexpression, single-step purification, and site-directed mutagenetic analysis of casbene synthase. Arch Biochem Biophys. 352: 144-152.
- Kennedy, K. and Thompson, R. 1993. Rapid synthesis of isoprenoid diphosphates and their isolation in one step using either thin layer or flash chromatography. J Chromatogr. 645: 161-167.
- Kitaoka, M., Nagashima, H., and Kamimura, S. 1989. Accumulation of geranylgeraniol of cell suspension culture of *Croton sublyratus* Kurz (Euphorbiaceae). Sankyo Kenkyusho Nenpo. 41: 169-173.
- Kitazawa, E., Sato, A., Tanahashi, S., Kuwano, H. and Ogiso, A. 1980. Novel diterpene lactones with anti-peptic ulcer activity from *Croton sublyratus*. Chem Pharm Bull. 28: 227-234.
- Knoess, W., and Reuter, B. 1996. Biosynthesis of [<sup>14</sup>C] Geranylgerayldiphosphate by a prenyl transferase system from a mutant strain of *Gibberella fujikuroi*. Anal Biochem. 239: 208-212.
- Ko, T., Chen, Y., Robinson, H., Tsai, P., Gao, Y., Chen, A., Wang, A., and Liang, P. 2001. Mechanism of product chain length determination and the role of a flexible loop in *Escherichia coli* undecaprenyl-pyrophosphate synthase catalysis. J Biol Chem. 50: 47474-47482.
- Kurokawa, T., Ogura, K., and Seto, S. 1971. Formation of polyprenylphosphates by a cell-free enzyme of *Micrococcus lysodeikticus*. Biochem Biophys Res Comm. 45: 251-257.
- Laemmli, U.K. 1970. Cleavage of structural protein during the assembly of the head of bacteriophage T4. Nature 227: 280-285.
- Liang, P.H., Ko, T.P., and Wang, A. 2002. Review article: Structure, mechanism and function of prenyltransferases. Eur J Biochem. 269: 3339-3354.
- Luckner, M., ed. 1990. Secondary metabolite in microorganisms, plants, and animals. 3<sup>rd</sup> ed. New York: Springer-Verlag.
- Mackie, H. and Overton, K.H. 1977. Hydrolysis and isomerization of *trans,trans*-farnesyl diphosphate by *Andrographis* tissue-culture enzymes. Eur J Biochem. 77: 101-106.

- Maeshima, M. 2000. Review: Vacuolar H<sup>+</sup>-pyrophosphatase. Biochim Biophys Acta. 1465: 37-51.
- Mahmoud, S.S., and Croteau, R.B. 2001. Metabolic engineering of essential oil yield and composition in mint by altering expression of deoxyxylulose phosphate reductoisomerase and menthofuran synthase. Proc Natl Acad Sci U S A. 98: 8915-8920.
- Mamiya, A., and Iso, T. 2003a. Shampoo compositions for animals containing surfactants and *Croton*. Jpn Kokai Tokkyo Koho. p 9.
- Mamiya, A., and Iso, T. 2003b. Topical compositions containing fungicides and polyprenyl compounds for treatment of tinea. Jpn Kokai Tokkyo Koho. p 8.
- Masuda, Y., Nakaya, M., Nakajo, S., and Nakaya, K. 1997. Geranylgeraniol potently induces caspase-3-like activity during apoptosis in human leukemia U937 cells. Biochem Biophys Res Comm. 234: 641-645.
- Mau, C.J.D., and West, C.A. 1994. Cloning of casbene synthase cDNA: evidence for conserved structural features among terpenoid cyclases in plants. Proc Natl Acad Sci U S A. 91: 8497-8501.
- Millis, J.R., Saucy, G.G., Maurina-Brunker, J., and McMullin, T.W. 2000. Vitamin production by fermentative biosynthesis of intermediates using genetically engineered microorganisms followed by chemical synthesis. PCT Int. Appl. WO 2000001650. 239 pp.
- Millis, J.R., Maurina-Brunker, J., and McMullin, T.W. 2003. Production of farnesol and geranylgeraniol. United State Patent Application: 20030092144.
- Mori, T., Sato, J., Fukumoto, T., Nakao, K., and Tamai, Y. 1996. Process for producing geranylgeraniol. European Patent Appl. 16 pp.
- Morimoto, H. 1988. Plaunotol manufacture by plant tissue culture of *Croton* species. Jpn. Kokai Tokkyo Koho. p5.
- Mould, R.M., and Robinson, C. 1991. A proton gradient is required for the transport of two luminal oxygen-evolving proteins across the thylakoid membrane. J Biol Chem. 266: 12189-12193.
- Mu, Y.Q., and Gibbs, R.A. 1995. Coupling of isoprenoid triflates with organoboron nucleophiles: Synthesis of all-*trans*-geranylgeraniol. Tetrahedron Lett. 36: 5669-5672.

- Muramatsu, M., and Obata, M. 2002. Geranylgeraniol biosynthetic production in *Gibberella fujikuroi* by inhibiting *ent*-kaurene synthase. Jpn Kokai Tokkyo Koho. JP 2002198884:10 pp.
- Muramatsu, M., et al. 2003. High production method of prenyl alcohols by microorganisms. United State Patent Application 20030096385.
- Myers, C.E., Trepel, J., Sausville, E., Samid, D., Miller, A., and Curt, G. 1997. Monoterpenes, sesquiterpenes and diterpenes as cancer therapy. United State Patent 5,602,184.
- Nah, J., Song, S.J., and Back, K. 2001. Partial characterization of farnesyl and geranylgeranyl diphosphatases induced in rice seedlings by UV-C irradiation. Plant Cell Physiol. 42: 864-867.
- Nakanishi, Y., Saijo, T., Wada, Y., and Maeshima, M. 2001. Mutagenic analysis of functional residues in putative substrate-binding site and acidic domains of Vacuolar H<sup>+</sup>-pyrophosphatase. J Biol Chem. 276: 7654-7660.
- Nielsen, H., Engelbrecht, J., Brunak, S., and von Heijne, G. 1997. Identification of prokaryotic and eukaryotic signal peptides and prediction of their cleavage sites. Protein Eng. 10:1-6.
- Nilubol, N. 1993. Process for extraction and purification of plaunotol. United State Patent 5,264,638.
- Ogiso, A. et al. 1985. A new anti-ulcer agent. Sankyo Kenkyusho Nempo. 37: 1-39.
- Ogiso, A., Kitazawa, E., Mikuriya, I., and Promdej, C. 1981. Original plant of a Thai crude drug, Plaunoi. Shoyakugaku Zasshi. 35: 287-90.
- Ogiso, A., Kitazawa, E., Kurabayashi, M., Sato, A., Takahashi, S., Noguchi, H., Kuwano, H., Kobayashi, S., and Mishima, H. 1978. Isolation and structure of antipeptic ulcer diterpene from Thai medicinal plant. Chem Pharm Bull. 26: 3117-3123.
- Ohizumi, H., Masuda, Y., Nakajo, S., Sakai, I., Ohsawa, S., and Nakaya, K. 1995. Geranylgeraniol is a potent inducer of apoptosis in Tumor cells. J Biochem. 117: 11-13.
- Ohnuma, S., Watanabe, M., and Nishino, T. 1996. Identification and characterization of geranylgeraniol kinase and geranylgeranyl phosphate kinase from the archaeobacterium *Sulfolobus acidocaldarius*. J Biochem. 119: 541-547.

- Oster, M.O., and West, C.A. 1968. Biosynthesis of *trans*-geranylgeranyl pyrophosphate in endosperm of *Echinocystis macrocarpa* Greene. Arch Biochem Biophys. 127: 112-23.
- Pattenden, G., and Jondiko, I.J.O. 1989. Terpenoids and an apocarotenoid from seeds of *Bixa orellana*. Phytochemistry. 28: 3159-3162.
- Pattenden, G., and Smithies, A.J. 1995. Concise syntheses of cembrenes based on radical-mediated vinylcyclopropane ring-opening reactions in casbene. J. Chem. Soc Perkin Trans. 1; 5/03368C: 57-61.
- Perez, L.M., Taucher, G., and Cori, O. 1980. Hydrolysis of allylic phosphates by enzymes from the flavedo of *Citrus sinensis*. Phytochemistry 19: 183-187.
- Pierrugues, O., Brutesco, C., Oshiro, J., Gouy, M., Deveaux, Y., Carman, G.M., Thuriaux, P., and Kazmaier, M. 2001. Lipid phosphate phosphatases in *Arabidopsis*. Regulation of the *AtLPP1* gene in response to stress. J Biol Chem. 276: 20300-20308.
- Ponglux, D., Wongseripipatana, S., Phadungchaoen, T., Raungrangsi, N., and Likhitwitayawuid, K. 1987. Medicinal Plant. Bangkok : Victory Power Point.
- Potduang, B. 2000. Isoprenoid biosynthesis in callus cultures of *Croton sublyratus*. Doctoral dissertation, Pharmaceutical Chemistry and Natural Products, Graduate School, Chulalongkorn University.
- Rajaonarivony, J., Gershenzon, J., Miyasaki, J., and Croteau, R. 1992. Evidence for an essential histidine residue in 4*S*-limonene synthase and other terpene cyclases. Arch Biochem Biophys. 299: 77-82.
- Robinson, C., and Bolhuis, A. 2001. Reviews: Protein targeting by the twin-arginine translocation pathway. Nature Review. 2: 350-356.
- Sambrooke, J., Fritsch, e.F., and Maniatis, T. Molecular cloning: A laboratory manual. 2<sup>nd</sup> ed. Cold Spring Harbor Laboratory Press: USA. Book 3.
- Sandmann, G., Hilgenberg, W., and Bieger, P. 1980. Enzymatic preparation of <sup>14</sup>C-labeled phytoene, squalene and geranylgeranyl pyrophosphate from [2-<sup>14</sup>C] Mevalonic acid. Z. Naturforsch. 35c: 927-930.
- Sato, K., Miyamoto, O., Inoue, S., and Iwase, N. 1988. Highly stereoselective total synthesis of plaunotol. Chem Lett: 1433-1436.

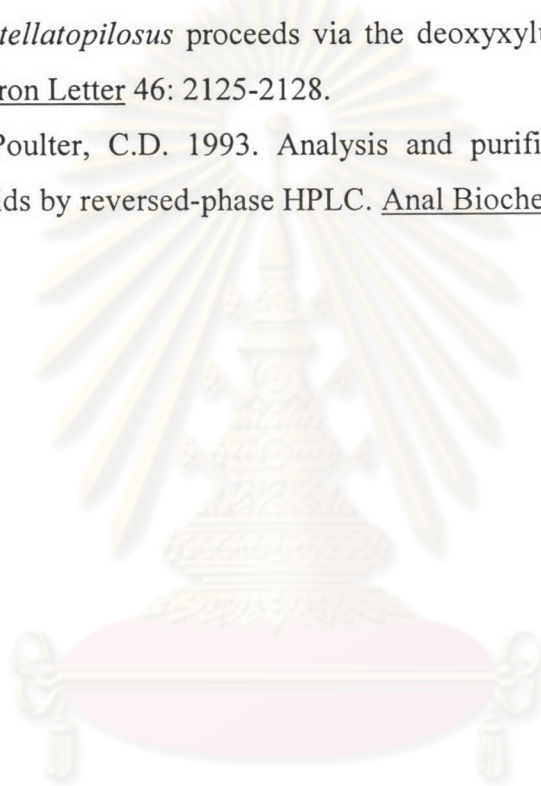


- Scher, M.G. and Waechter, C.J. 1984. Brain dolichyl propphosphate phosphatase. Solubilization, characterization, and differentiation from dolichyl monophosphate phosphatase activity. J Biol Chem. 259 : 14580-14585.
- Schubert, M., Petersson, U.A., Haas, B.J., Funk, C., Schroeder, W.P., and Kieselbach, T. 2002. Proteome map of the chloroplast lumen of *Arabidopsis thaliana*. J Biol Chem. 277; 8354-8365.
- Scolnick. 1999. WO99/66929 cited in Tan, B. et al., 2002.
- Shibata, M., Mikota, T., Yoshimura, A., Iwata, N., Tsuyama, M., and Kobayashi, Y. 2004. Chlorophyll formation and photosynthetic activity in rice mutants with alterations in hydrogenation of the chlorophyll alcohol side chain. Plant Sci. 166: 593-600.
- Sitthithaworn, W., Kojima, N., Viroonchatapan, E., Suh, D.Y., Iwanami, N., Hayashi, T., Noji, M., Saito, K., Niwa, Y., and Sankawa, U. 2001. Geranylgeranyl diphosphate synthase from *Scoparia dulcis* and *Croton sublyratus*. Plastid localization and conversion to a farnesyl diphosphate synthase by mutagenesis. Chem Pharm Bull. 49: 197-202.
- Stafford, H.A. 1990. Recent advances in phytochemistry vol.24 Biochemistry of the mevalonic acid pathway to terpenoids. New York: Plenum Press. pp 99-160.
- Stukey, J. and Carman, G.M. 1997. For the record: Identification of a novel phosphatase sequence motif. Protein Sci. 6: 469-472.
- Takayanagi, H. 1994. Z-selective formation of trisubstituted  $\alpha$ - $\beta$ -unsaturated nitrile by the Horner-Emmon reaction. Tetrahedron Letters. 35: 1581-1584.
- Takeda, Y., Nakao, K., Nakata, K., Kawakami, A., Ida, H., Ichikawa, T., shigeno, M., Kajiya, Y., Hamasake, K., Kato, Y., and Eguchi, K. 2001. Geranylgeraniol an intermediate product in mevalonate pathway, induces apoptosis cell death in human hepatoma cells: death receptor-independent activation of caspase-8 with down-regulation of Bcl-xL expression. Japanese J Cancer Res. 92: 918-925.
- Tako, K., Arai, M., and Kogen, H. 2000. A practical total synthesis of plaunotol *via* highly Z-selective Wittig olefination of  $\alpha$ -acetal ketones. J Chem Soc., Perkin Trans 1: 2073-2078.

- Tan, B., and Foley, J. 2002. Tocotrienols and geranylgeraniol from *Bixa orellana* by products. United States Patent 6,350,453.
- Tansakul, P. 1996. Study on the enzyme geranylgeraniol-18-hydroxylase in the biosynthesis of plaunotol in *Croton sublyratus* Kurz. Master's Thesis, Department of Pharmacognosy, Graduate School, Chulalongkorn University.
- Tansakul, P., and De-Eknamkul, W. 1998. Geranylgeraniol-18-hydroxylase: The last enzyme on the plaunotol biosynthetic pathway in *Croton sublyratus*. Phytochemistry. 47: 1241-1246.
- Thai, L., Rush, J.S., Maul J.E., Devarenne, T., Rodgers, D.L., Chappell, J., and Waechter, C.J. 1999. Farnesol is utilized for isoprenoid biosynthesis in plant cells *via* farnesyl pyrophosphate formed by successive monophosphorylation reactions. Proc Natl Acad Sci U S A. 96: 13080-13085.
- Toke, D.A., McClintick, M.L., and Carman, G.M. 1999. Mutagenesis of the phosphatase sequence motif in diacylglycerol pyrophosphate phosphatase from *Saccharomyces cerevisiae*. Biochemistry. 38: 14606-14613.
- Tokuhiro, K., Muramoto, N., Yamada, Y., Asami, O., Hirai, M., Obata, S., Ohto, C., and Muramatsu, M. 2004. Prenyl alcohol production by overexpression of prenyl diphosphate phosphatase in yeast *Saccharomyces cerevisiae*. Available from <http://www.ncbi.nlm.nih.gov/entrez/viewer.fcgi?db=nucleotide&val=26005744> [2004, June 02]
- Trapp, S.C., and Croteau, R. 2001. Genomic organization of plant terpene synthases and molecular evolutionary implication. Genetics. 158: 811-832.
- Tsai, S.C., and Gaylor, J.L. 1966. Testicular steroids. V. Preparation and partial purification of a microsomal prenyl by pyrophosphate pyrophosphohydrolase. J Biol Chem. 241: 4043-4050.
- Vongchareonsathit, A., De-Eknamkul, W. 1998. Rapid TLC-Densitometric analysis of plaunotol from *Croton sublyratus* leaves. Planta Med. 64: 279-80.
- Walker, K., and Croteau, R. 2001. Taxol biosynthetic genes. Phytochemistry. 58: 1-7.
- Wang, K.C., and Ohnuma, S. 2000. Review isoprenyl diphosphate synthase. Biochim Biophys Acta. 1529: 33-48.
- Widlanski, T.S., and Taylor, W. 1999. Chemistry and enzymology of phosphatases. In Barton D, Nakanishi K, and Cohn OM. Comprehensive natural products

chemistry volume 5: Enzymes, enzyme mechanism, proteins, and aspects of no chemistry. Amsterdam: Elsevier.

- Wise, M.L., Savage, T.J., Katahira, E., and Croteau, R. 1998. Monoterpene synthases from common sage (*Salvia officinalis*): cDNA isolation, characterization, and functional expression of (+)-sabinene synthase, 1,8-cineole synthase, and (+)-bornyl diphosphate synthase. J Biol Chem. 273: 14891-14899.
- Wungsintaweekul, J., and De-Eknamkul, W. 2005. Biosynthesis of plaunotol in *Croton stellatopilosus* proceeds via the deoxyxylulose phosphate pathway. Tetrahedron Letter 46: 2125-2128.
- Zhang, D., and Poulter, C.D. 1993. Analysis and purification of phosphorylated isoprenoids by reversed-phase HPLC. Anal Biochem. 213: 356-361.



ศูนย์วิทยทรัพยากร  
จุฬาลงกรณ์มหาวิทยาลัย

## VITA

Mrs Natsajee (Suwannaroj) Nualkaew was born on August, 23, 1968 in Ubolratchathani, Thailand. She received her Bachelor's degree of Pharmacy in 1991 from Mahidol University, and received Bachelor's degree of Business Administration (General Management) in 1995 from Sukhothai Thammathirat Open University, Thailand. She received Master of Science (Pharmacy) in 1997, Mahidol University, Thailand. In 1991-1994, she was a pharmacist in Phra Arjarn Phan Arjaro Community Hospital (โรงพยาบาลพระอาจารย์ฝั้น อาจาโร), Sakol Nakorn. At present, she is a member of the Department of Pharmaceutical Botany and Pharmacognosy, Faculty of Pharmaceutical Sciences, Khon-Kaen University, Thailand. During her Ph.D. study, she received the Royal Golden Jubilee Ph.D. Program, The Thailand Research Fund (TRF) in the year 2000, and the German Academic Exchange (DAAD) for some parts of her thesis in Germany



ศูนย์วิทยทรัพยากร  
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