เอกสารอ้างอิง

ภาษาไทย

วัลยา เดชชัยกุล, "การผลิตและการศึกษาของเอนไซม์ไซโคลเดกซ์ทริน กลูคาโนทรานสเฟอเรส จาก *Bacillus* spp., (วิทยานิพนธ์ปริญญามหาบัณฑิต จุฬาลงกรณ์มหาวิทยาลัย, 2534) หน้า 105-106.

ศิริพร สิทธิประณีต, "อะกาโรสเจลอิเลคโทรโฟริซิส," ใน พันธุวิศวกรรม : ปฏิบัติการเบื้องต้น (กรุงเทพมหานคร : โรงพิมพ์ ส.วิชาญการพิมพ์, 2531) หน้า 73-88.

อุไรวรรณ รัชธร, "การผลิตเอนไซม์ไซโคลเดกซ์ทรินไกลโคซิลทรานสเฟอเรสในถังหมักและการตรึงเอนไซม์,(วิทยานิพนธ์ปริญญามหาบัณฑิต จุฬาลงกรณ์มหาวิทยาลัย, 2536).

ภาษาอังกฤษ

Ausubel, F.M., et al., "Enzymatic Manipulation of DNA and RNA," in Current protocols in Molecular Biology, (New York: Greene Publishing Associates and Wiley-Interscience, 1989), Charpter 3.

Backman, K., "A cautionary note on the use of certain restriction endonuclease with methylated substrates," Gene, 2(1980): 167-177.

Bender, H., "Kinatic studies of 1-4-α-D glucopyranosyl transfer reactions catalyzed by cyclodextrin glycosyltransferase EC-2.4.1.19 especially of the cyclization reaction with 1-4-α-D glucopyranosyl chains average degree of polimerization of 16 as substrate," Carbohydrate Research, 78(1980): 133-146.

_____, "Enzymology of the cyclodextrin," Proceedings of the First International Symposium on Cyclodextrins, Hungary (Sept. 30-Oct. 2, 1981): 77-87.

_____, "Studies of the inhibition by malto-oligosaccharides of the cyclization reaction catalyzed by the cyclodextrin glycosyltransferase EC-2.4.1.19 from *Klebsiella pneumoniae* M5a1 with glycogen," Carbohydrate Research, 135(1985): 291-302.

_____, "Studies on the reaction mechanism of cyclodextrin glycosyltransferase : subsite analysis," Proceedings of the Fourth International Symposium on Cyclodextrins, West Germany (April 20-22, 1988): 19-26.

Binder, F., Huber, O., and Bock, A., "Cyclodextrin-glycosyltransferase form *Klebsiella pneumoniae* M5a1: cloning, nucleotide sequence and expression," Gene, 47(1986): 269-277.

Birnboim, H.C., and Doly, J., "A rapid alkaline extraction procedure for screening recombinant plasmid DNA," Nucleic Acid Res., 7(1979): 1513-1523.

Bolivar, F., Rodriguez, R.L., Greene, P.J., Betlach, M.C., Heyneker, H.L., Boyer, H.W., Crosa, J.H. and Falkow, S., "Construction and characterization of new cloning vehicles.II. A multi purpose cloning system," Gene, 2(1977): 95-114.

Bolivar, F., and Backman, K., "Plasmid of *Escherichia coli* and cloning vectors," Methods Enzymol., 68(1979): 245-267.

Dente, L., Cesareni, G., and Cortese, R., "pEABL : a new family of single stranded plasmid," Nucleic Acid Res., 11(1983): 1645-1655.

Elledge, S.J., and Davis, R.W., "Position and density effects on repression by stationary and mobile DNA-binding proteins," Genes Dev., 3(1989): 185-197.

Englbrecht, A., Harrer, G., Lebret, M., and Schmid, G., "Biochemical and genetic characterization of a CGTase form an Alkalophilic bacterium Forming Primarily γ-cyclodextrin," Minutes Fifth International Symposium on Cyclodextrins, France (March 28-30, 1990): 25-31.

French, D., and Rudle, R.E., "The molecular weights of the Schardinger alpha and beta Dextrins," J. Am. Chem. Soc., 64 (1942): 1651.

Freudenberg, K., and Cramer, F., "Die konstitution der Schardinger dextrin alpha, beta and gamma," Z. Naturforsch., B3(1948): 464.

Froming, K.H., "Cyclodextrin in parmaceutical industry," Proceeding of the first International Symposium on Cyclodextrins, Hungary (Sept. 30-Oct. 2, 1981): 376-376.

Georganta, G., et al., "Expression of the CGTase gene of Alkalo philic *Bacillus* No.38-2 in various hosts," Strach, 43(1991) : 361-363.

Hamamoto, T., Kaneko, T., and Horikoshi, K., "Nucleotide sequence of the cyclomaltodextrin glucanotransferase (CGTase) gene from Alkalophilic *Bacillus sp.* Strain No. 38-2," Agric. Biol. Chem., 51(1987): 2019-2022.

Hoffmann, B.E., Bender, H., and Schulz, G.E., "Three-dimensional structure of cyclodextrin glucosyltransferase from *Bacillus circulans* at 3.4 Å resolution," J. Mol. Biol., 209(1989): 793-800.

Horikoshi, K., "Enzymology and molecular genetic of CD-forming enzyme," Proceeding of the Fourth International Sympasium on Cyclodextrins, Munich (April 20-22, 1988): 7-17.

Horikoshi, K., Nakamura, N., Matsuzawa, N., and Yamamoto., "Indus trial production of cyclodextrins," Proceedings of the First International Symposium on Cyclodextrins, Hungary (Sept. 30-Oct. 2, 1981): 25-39.

Horikoshi, K., Kaneko, T., and Hamamoto, T., "Molecular cloning and nucleotide sequence of the cyclomaltodextrin glucanotrans ferase gene form the Alkalophilic *Bacillus* sp. strain No. 38-2," Journal of General Microbiology, 134(1988): 97-105.

Kaneko, T., Kato, T., Nakamura, N., and HoriKoshi, K., "Spectrophoto metric determination of cyclization activity of beta-cyclo dextrin glucanotransferase," Journal of the Japaness Society of Starch Science, 34(1987): 45-48.

Kaneko, T., Hamamoto, T., and Horikoshi, K., "Molecular cloning and nucleotide sequence of the cyclomaltodextrin glucanotrans ferase gene form the Alkalophilic *Bacillus sp.* Strain No. 38-2," Journal of General Microbiology, 134(1988): 97-105.

Kaneko, T., et al., "Construction of a chimeric series of *Bacillus* cyclomaltodextrin glucanotransferases and analysis of the thermal stabilities and pH optima of the enzymes," Journal of General Microbiology, 135(1989): 3447-3457.

Kato, T., and Horikoshi, K., "Cloning and expression of the *Bacillus subtilis* No.313 γ-cyclodextrin forming CGTase gene in *Escherichia coli*," Agric. Biol. Chem., 50(1986): 2161-2162.

_____, "Gamma-cyclodextrin a new gamma-cyclodextrin forming enzyme produced by *Bacillus subtilis* No. 313," J. Jan. Soc. Starch Sci., 2(1986) : 137.

Kimura, K., et al., "Nucleotide sequence of the β-cyclodextrin glucanotransferase gene of Alkalophilic *Bacillus sp.* Strain 1011 and similarity of its amino acid sequence to those of α-amylases," Journal of Bacteriology, 169(1987): 4399-4402.

Kimura, K., et al., "Functions of the COOH-terminal region of cyclo dextrin glucanotransferase of Alkalophilic *Bacillus* sp #1011 :relation to catalyzing activity and pH stability," Biochemi cal and Biophysical Research Communications, 161(1989): 1273 -1279.

Kimura, K., Takano, T., and Yamane, K., "Molecular cloning of the β-cyclodextrin synthetase gene from an Alkalophilic *Bacillus* and its expression in *Escherichia coli* and *Bacillus subtilis*," Appl. Microbiol Biotechnol., 26(1987): 149-153.

Klein, C., and Schulz, G.E., "Structure of cyclodextrin glycosyl transferase refined at 2.0 Å resolution," J. Mol. Biol., 217(1991): 737-750.

Komiyama, M., and Bender, M., "Cyclodextrin as Enzyme Models," in The Chemistry of Enzyme Action, (Elsvier Science Publisher B.V., 1984), pp. 505-527.

Lloyed, N.E., and Nelson, W.J., "Glucose-fructose containing sweet eners from starch," in Starch, (Whistler, R.L., Bc Miller, J.N., and Paschall, E.F., Eds. Academic Press ; New York, 1984).

Luria, S.E., Adams, J.N., and Teng, R.C., "Transduction of lactose utilizing ability among strains of the *Escherichia coli* and *Shigella dysenteriae* and the properties of the transducing phage particles," Virology, 13(1960): 348-390.

Mandel, M., and Higa, A., "Calcium chloride depedent bacteriophage DNA infection," J.Mol.Biol., 53(1970): 159-162.

Maniatis, T., Sambrook, J., and Fritsch, E.F., Molecular cloning : A Laboratory Manual, (Clod Spring Harbor Laboratory Press., 2nd edition, 1989), pp. 1.12-1.13, 6.12.

Messing, J., "New M13 vectors for cloning," Methods Enzymol., 101(1983): 20-78.

Messing, J., Crea, R., and Seeburg, P.H., "A System for shotgun DNA sequencing," Nucleic Acid Res., 9(1981): 309-321.

Nakamura, N., and Horikoshi, K., "Purification and properties of cyclodextrin glycosyltransferase of an alkalophilic *Bacillus* sp.," Agric. Biol. Chem., 40(1976): 935-941.

Nitschke, L., et al., "Molecular cloning, nucleotide sequence and expression in *Escherichia coli* of the β-cyclodextrin glycosyltransferase gene from *Bacillus circulans* strain No.8," Appl. Microbiol. Biotechnol. 33(1990): 542-546.

Nomoto, M., et al., "Cyclodextrin glucanotransferase from Alkalo philic Bacteria of Taiwan," Agric. Biol. Chem., 48(1984): 1337-1338.

Norrander, J. Kempe, T., and Messing, J., "Construction of improved M13 vectors using oligodeoxynucleotide-directed muta genesis," Gene, 26(1983): 101-106.

Okada, S., and Kitahata, S., "Method of Purification of Cyclodextrin Producing Enzymes," US patent 3,888,738, 10 June 1975.

Paloheimo, M., et al., "Production of cyclomaltodextrin glucanotrans ferase of *Bacillus circulans* var. alkalophilus ATCC21783 in *B. subtilis.*" Applied microbiology and Biotechnology, 36 (1992): 584-591.

Park, C.S., Park, K.H., and Kim S.H., "A rapid screening method for alkaline β-cyclodextrin glucanotransferase using phenol phalein-methyl orange-containing-solid medium," Agric. Biol. Chem., 53(1989): 1167-1169.

Pongsawasdi, P., and Yagisawa, M., "Screening and identification of a cyclodextrin glucanotransferase-producing bacteria," J. Ferment. Techonol., 65(1987): 463-467.

Pulley, P.O., and French, D., "Study on Schardinger dextrin-XI. the isolation of new Schardinger dextrin," Biochem. Biophysic. Res. Com., 5(1961): 11-15.

Raleigh, E. A., Lech, K., and Brent, R., Current Protocols in Molecular Biology eds. (Ausubel, F.M., et al., Publishing Associates and Wiley Interscience ; New York, 1989), Unit 1.4.

Rodringuez, R.L., and Tsit, R.C., Recombinant DNA Techniques : An Introduction, (Addison-Wasley Publishing Co., 1983), pp.45-46.

Saenger, W., "Cyclodextrin inclusion compound in research and industry," Angew. Chem., Int. Ed. Engel., 19(1980): 344-362.

Schmid, G., "Cyclodextrin glycosyltransferase production : yield enhancement by overexpression of cloned gene," TIBTECH, 7(1989): 244-248.

Schmid, G., Englbrecht., and Schmid, D., "Cloning and nucleotide sequence of a cyclodextrin glycosyltransferase gene from the Alkalophilic *Bacillus* 1-1," Proceeding of the Fourth International Symposium on Cyclodextrins, Munich, West Germany (April 20-22, 1988): 71-76.

Schmid, G., Huber, O.S., and Eberle, "Selective complexing agents for the production of γ-cyclodextrin," Proceeding of the Fourth International Symposium on Cyclodextrins, Munich, West Germany (April 20-22, 1988): 87-92.

Sibakov, M., "High expression of *Bacillus licheniformis* α-amylase with a *Bacillus* secretion vector," Eur J. Biochem, 155(1986) : 577-581.

Starnes, R.L. "Industrial potential of cyclodextrin glycosyl transferase," American Association of Cereal Chemists, Inc., 35(1990): 1094-1099.

Starnes, R.L., Flint, V.M., and Katkocin, D.M., "Cyclodextrin Production with a highly thermostable from *Thermoanaerobacter* sp.," Minutes fifth International Symposium on Cyclodextrin, France (March 28-30, 1990): 55-61.

Sutcliffe, J.G., "Complete nucleotide sequence of the *Escherichia coli* plasmid pBR322," Cold Spring Harbor Symp. Quant. Biol., 43(1979): 79.

Szejtli, J., "Cyclodextrins in food, cosmetics and toiletries," Proceeding of the First International Symposium on Cyclo dextrins, Hungary (Sept. 30- Oct. 2, 1981): 469-480.

_____, "Cyclodextrins," in Cyclodextrin Technology, (Dordrecht : Kluwer Academic Publishers, 1988), chapter 1.

Takano, T., et al., "Molecular cloning, DNA nucleotide sequencing, and expression in *Bacillus subtilis* cells of the *Bacillus macerans* cyclodextrin glucanotransferase gene," Journal of Bacteriology, 166(1986): 1118-1122.

Vandamme, E.J., "Penicillin acylase and β-lactamase in Economic microbiology vol. 5," in Microbial Enzyme and Bioconversion, (Academic Press Inc., 1980), pp. 468-522.

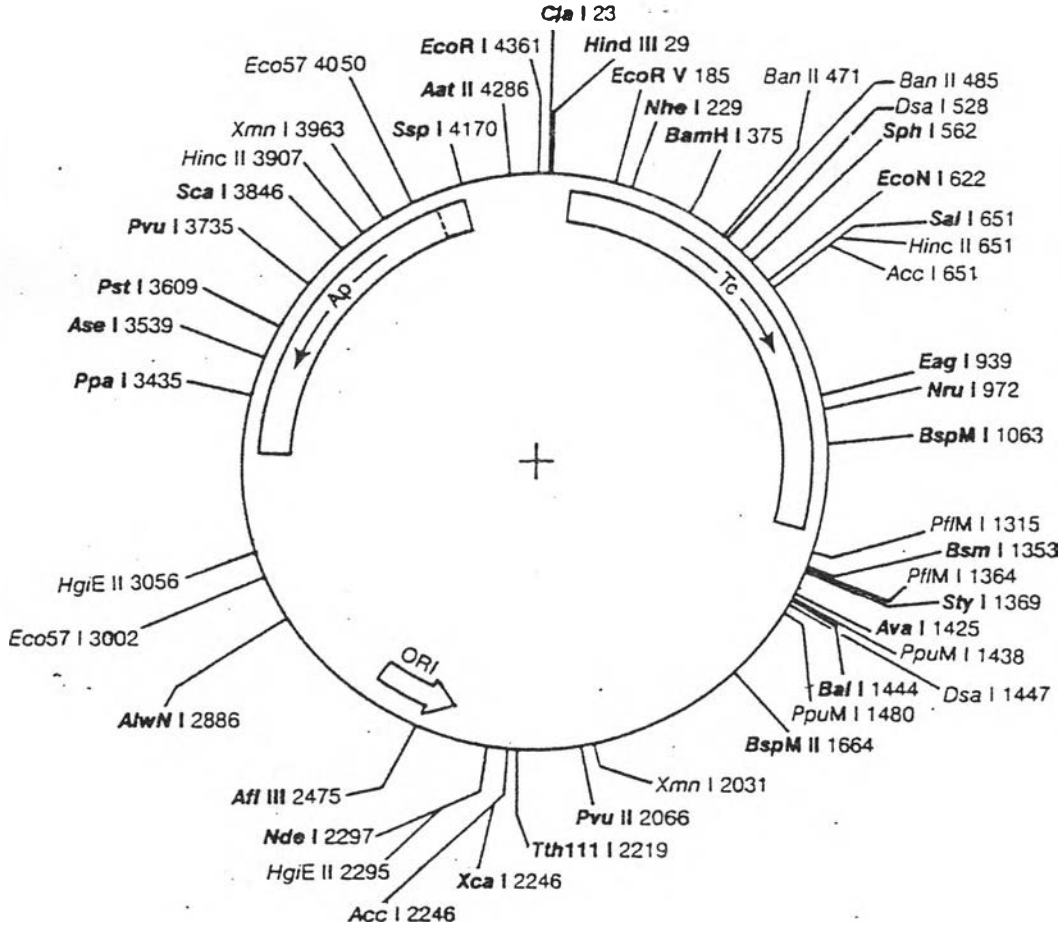
Vasantha, N., and Thompson, L.D., "Secretion of a heterologous protein from *Bacillus subtilis* with the aid of protease signal sequence," J. Bacteriol., 165(1986): 837-842.

Yamamoto, M., Tanaka, T., and Horikoshi, K., "Alkaline amylase of alkalophlic bacteria," Agric. Biol. Chem,, 36(1972): 1819-1823.

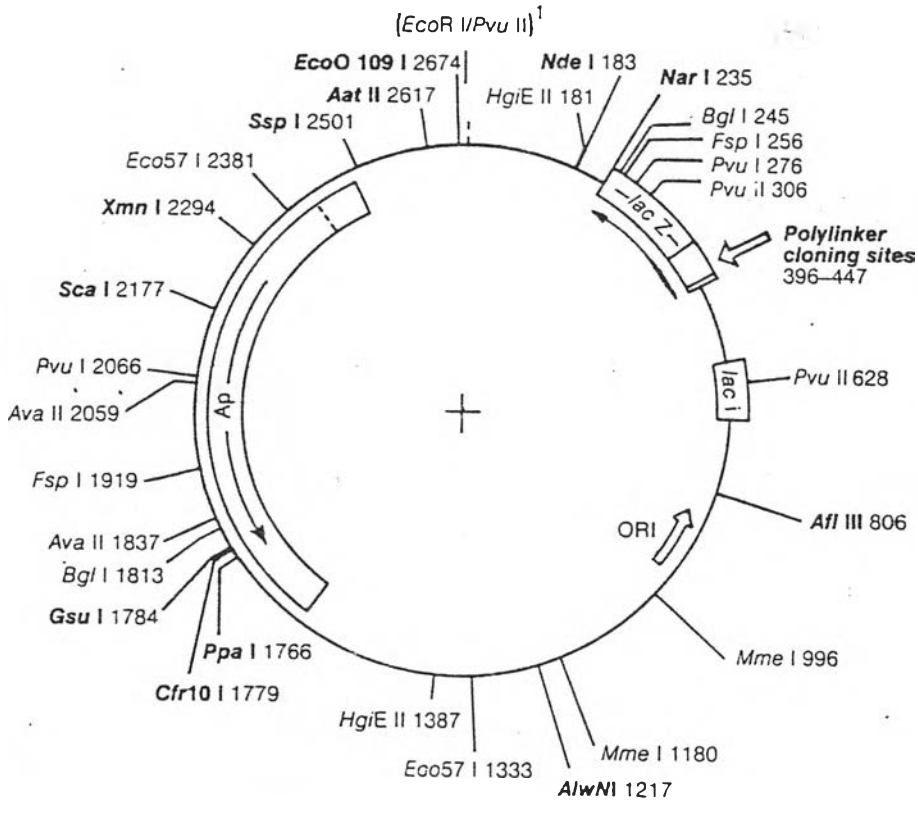
Yanish-Perron, C., Viera, J., and Messing, J., "Improved M13 phage cloning vectors and host strains : nucleotides sequences of the M13mp18 and pUC19 vector," Gene, 33(1985): 103-119.

ภาคผนวก

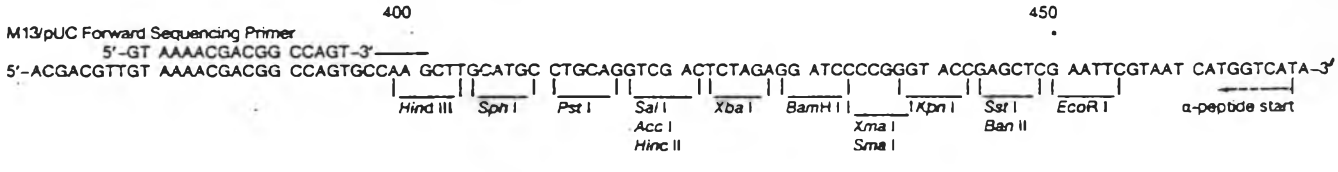
ภาคผนวกที่ 1 Restriction map ของดีเอ็นเอพาหะ pBR322 (Bolivar และคณะ, 1977 ; Sutcliffe, 1949)



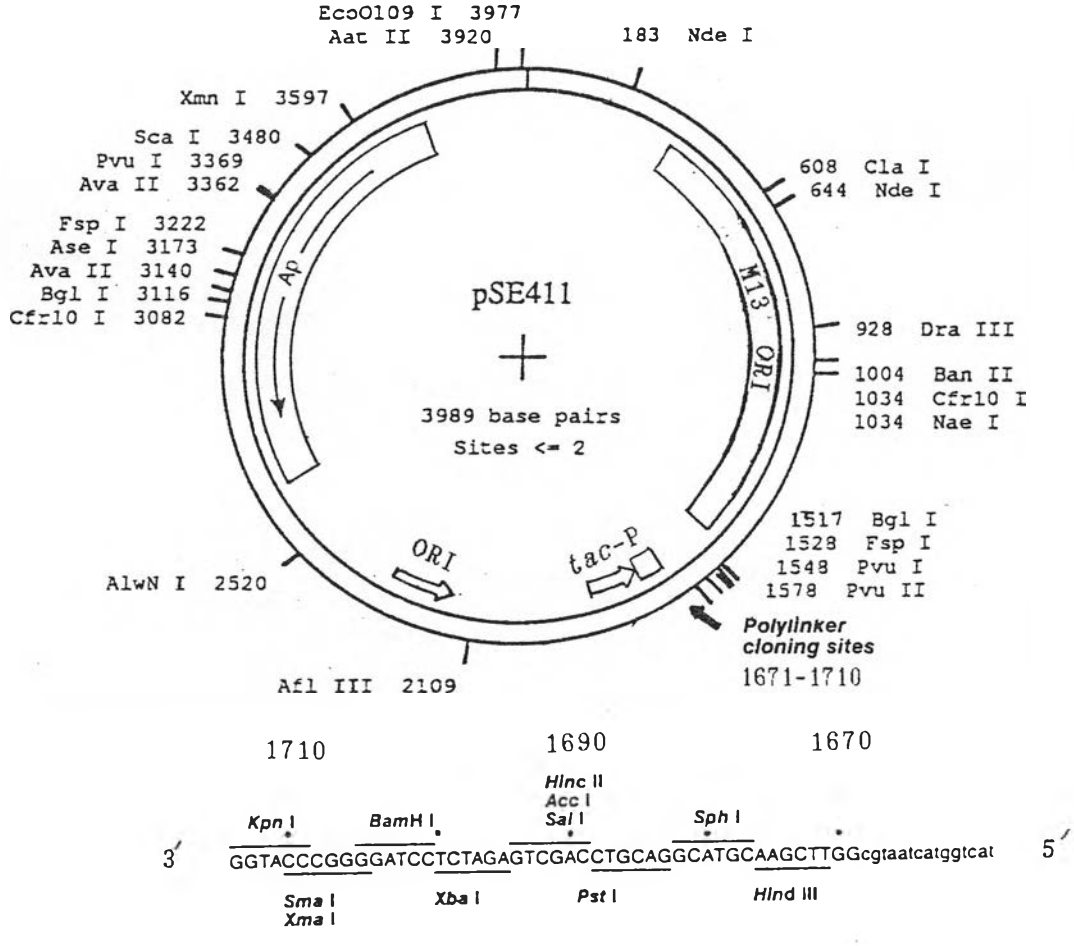
<u>ภาคผนวกที่ 2</u> Restriction map ของดีเอ็นเอพาหะ pUC18 (Messing, 1983; Yanisch และคณะ, 1985)



pUC18 multiple cloning site and primer binding region: 371-480



ภาคผนวกที่ 3 Restriction map ของพลาสมิดเอ็นเอพาหะ pSE411 (Dente และคณะ, 1983; Elledge และ Davis, 1989)



ภาคผนวกที่ 4 Effect of NaCl concentration on restriction endonuclease activity (Ausuble และคณะ, 1989)

Enzyme	0 mM NaCl	50 mM NaCl	100 mM NaCl	150 mM NaCl
AccI	+++	+++	+	+
BamHI	+	++	+++	+++
BglII	++	+++	+++	+++
ClaI	+++	+++	+++	++
EcoRI	*	+++	+++	+++
HindIII	++	+++	+++	++
HpaI	+	+++	+++	+
KpnI	+++	+	+	+
MluI	++	+++	+++	++
NdeI	+	+	++	+++
PstI	+++	+++	+++	+++
PvuII	+++	+++	+++	+++
SalI	+	+	++	+++
Sau3AI	+++	+++	+++	+++
ScaI	+	+++	+++	++
XbaI	+	+++	+++	+++
XhoI	++	+++	+++	+++

ภาคผนวกที่ 4 (ต่อ)

Scoring: +++ indicates that between 30-100 % of the activity can be obtained

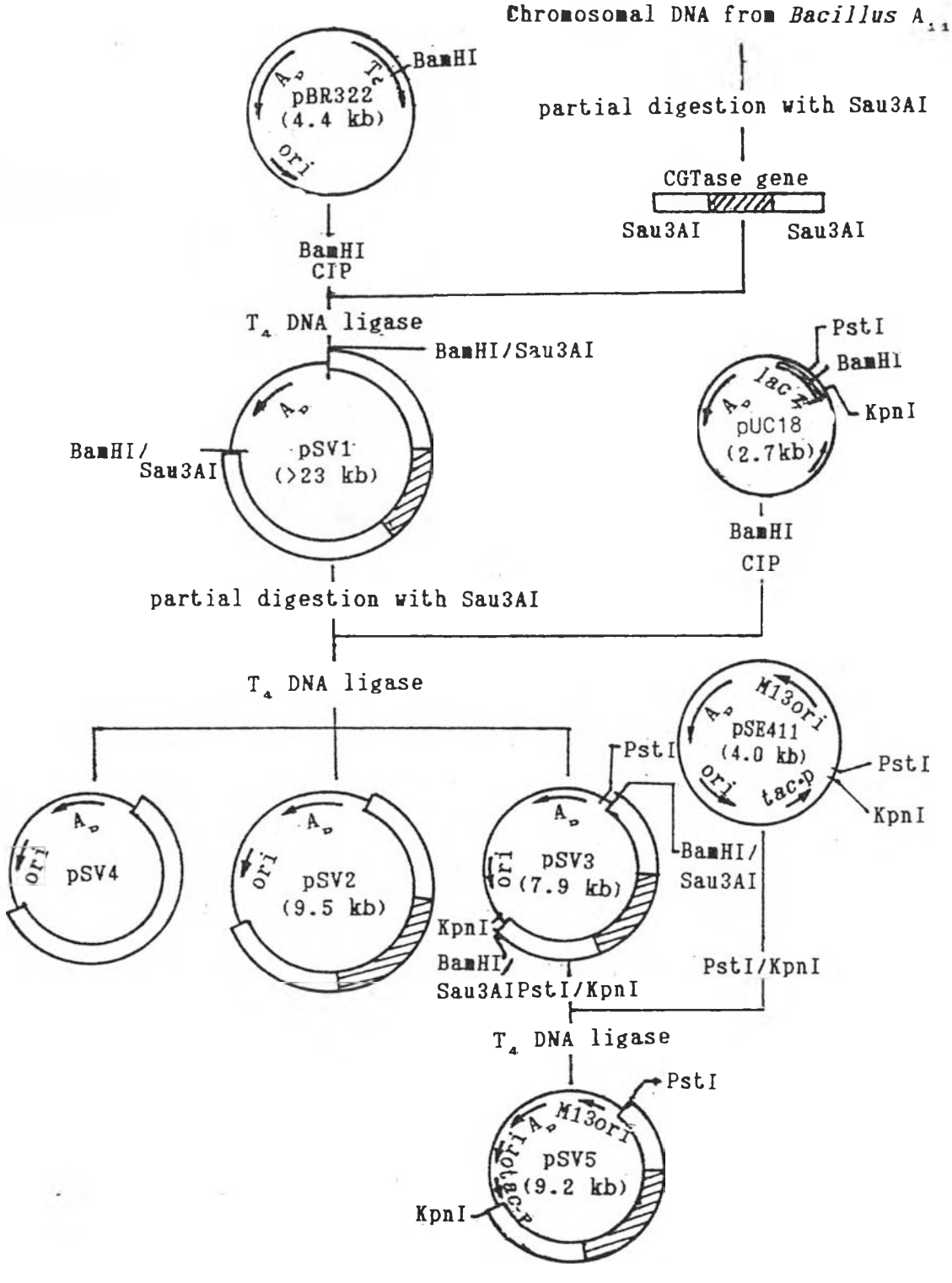
++ indicates that between 10-30 % of the activity can be obtained

+ indicates that between < 10 % of the activity can be obtained

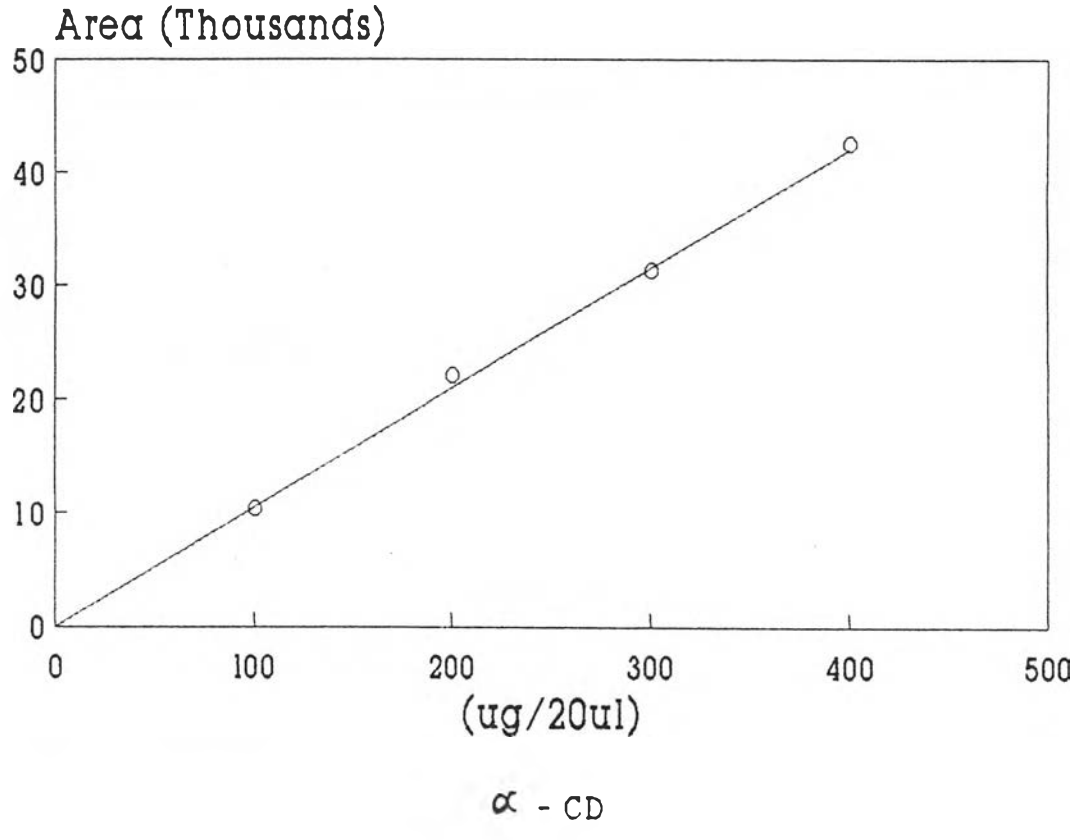
* not recommended because of star activity

Star activity หมายถึง การที่เรสติกชั่นเอนไซม์ย่อยดีเอ็นเอในลำดับที่คล้ายกับลำดับเบสที่จำเพาะ เช่น EcoRI จะย่อยดีเอ็นเอในบริเวณที่มีลำดับเบส 5′..G|AATTC..3′ ซึ่งเป็นลำดับเบสที่จำเพาะ แต่ถ้าเกิด star activity ขึ้น EcoRI* จะสามารถย่อยดีเอ็นเอที่มีลำดับเบส 5′..N|AATTC..3′ สภาวะที่เกิด star activity ขึ้น มักพบในสภาวะ high endonuclease concentration, low ionic strength, substitution of manganese for magnesium, high pH และ การมีสารละลายอินทรีย์บางชนิด เช่น glycerol และ DMSO ใน reaction mixture

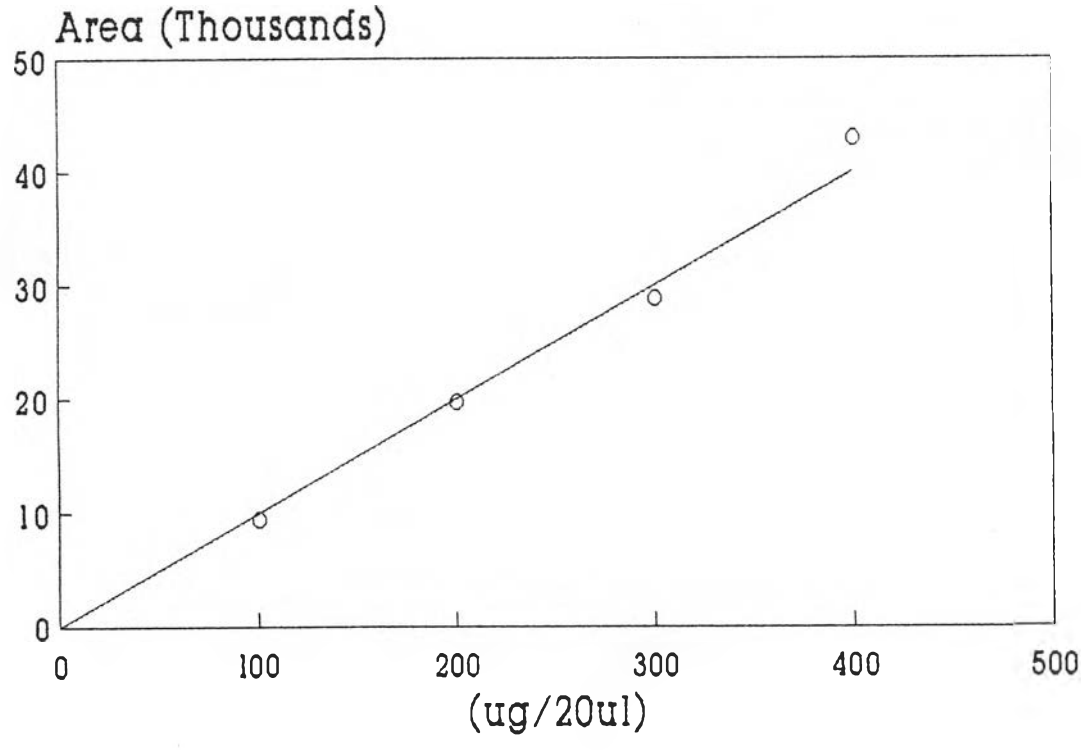
ภาคผนวกที่ 5 แสดงการสร้างรีคอมบิแนนท์พลาสมิด pSV1, pSV2, pSV3, pSV4 และ pSV5



ภาคผนวกที่ 6 กราฟมาตรฐานสำหรับการหาปริมาณ α-CD โดยวิธี HPLC

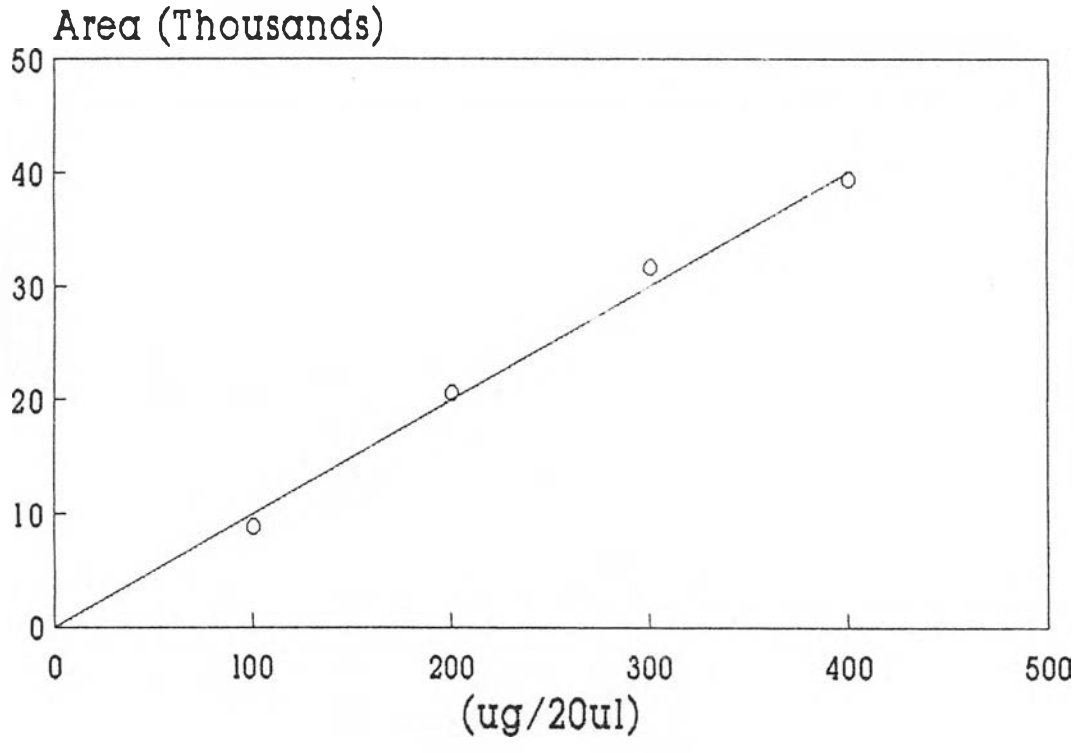


ภาคผนวกที่ 7 กราฟมาตรฐานสำหรับการหาปริมาณ β-CD โดยวิธี HPLC



β - CD

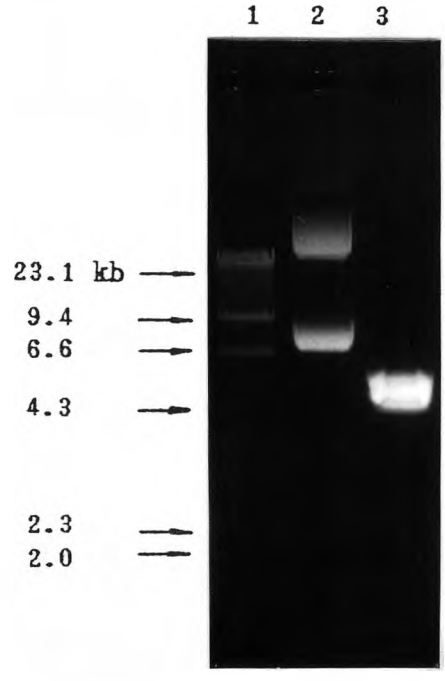
ภาคผนวกที่ 8 กราฟมาตรฐานสำหรับการหาปริมาณ ช-CD โดยวิธี HPLC



ช - CD

งานเพิ่มเติมหลังวิทยานิพนธ์

จากการย่อยรีคอมบิแนนท์พลาสมิด pSV5 ด้วยเรสติกชั่นเอนไซม์ PstI และ SalI พบว่าตำแหน่ง SalI ห่างจาก PstI บนดีเอ็นเอพาหะประมาณ 4.7 kb (รูปที่ 34) ซึ่งตรงกับตำแหน่งของ AccI 1 ตำแหน่งบน inserted DNA fragment



รูปที่ 34 ผลของการศึกษาขนาดและ restriction site ของรีคอมบิแนนท์พลาสมิด pSV5 บนอะกาโรสเจล 1.0 เปอร์เซนต์

ช่องที่ 1 คือ standard λ-DNA ย่อยด้วย HindIII

ช่องที่ 2 คือ รีคอมบิแนนท์พลาสมิด pSV5

ช่องที่ 3 คือ รีคอมบิแนนท์พลาสมิด pSV5 ย่อยด้วย PstI และ SalI

ประวัติผู้เขียน

นายสุรศักดิ์ ศิรินรอดุลศิลป์ เกิดวันที่ 19 พฤษภาคม พ.ศ.2508 ณ.จังหวัดขอนแก่น สำเร็จการศึกษาวิทยาศาสตรบัณฑิต สาขาชีววิทยา คณะวิทยาศาสตร์ มหาวิทยาลัยเชียงใหม่ เมื่อปี พ.ศ.2531 และเข้าศึกษาต่อในหลักสูตรปริญญามหาบัณฑิต ภาควิชาชีวเคมี ที่จุฬาลงกรณ์มหาวิทยาลัย เมื่อ พ.ศ. 2533