

REFERENCES

- Abe, J., Nakajima, K., Nagano, H., Hizukuri, S. and Obata, K. (1988) Carbohydr. Res. 175: 85-92.
- Amaizo. (1991) Cyclo-dextrins USA (Mimeo graphed).
- _____. (1993) Cavitron Cyclo-dextrins : A Breakthrough for Molecular Encapsulation USA (Mimeo graphed).
- Antenucci, R. N., and Palmer, J. K. (1984) J. Agric. Food Chem. 32 : 1316-1321
- Armbruster, C.F. (1988) Use of cyclohexane in the production of pure alpha- and beta cyclodextrins. In O. Huber and J. Szejtli (eds.), Proceedings of the Fourth International Symposium on Cyclodextrins West Germany : 33-39.
- _____, and Jacaway, W.A. Jr. (1972), US Patent 3,640,847.
- Barcza, L. and Seres, G. (1988) Method development for Economic Production of Cyclodextrins by Means of Ternary Complex Formation. In O. Huber and J. Szejtli (eds.), Proceedings of the Fourth International Symposium on Cyclodextrins West Germany : 81-86.
- Bender, H. (1977) Cyclodextrin-Glucanotransferase von *Klebsiella pneumoniae* 1. Synthese, Reinigung und Eigenschaften des Enzyms von *K. pneumoniae* M 5 al. Arch. Microbiol. 111 : 271.
- _____. (1977) Cyclodextrin-Glucanotransferase von *klebsiella pneumoniae* 2. Bedeutung des Enzyme fur den Metabolismus der Cyclodextrin bei *K. pneumoniae* M 5 al. Arch. microbiol. 113 : 49.
- _____. (1981) Eur. J. Biochem 115 : 287-291.
- _____. (1982) Enzymology of the Cyclodextrins. In J. Szejtli (ed.), Proceedings of the First International Symposium on Cyclodextrins Budapest : 77-87.

- _____. (1983) An improve method for the preparation of cyclooctaamylose, using starches and the cyclodextrin glycosyltransferase of *Klebsiella pneumoniae* M 5 al. Carbohydr. Res. 124: 225.
- _____. (1984) Verfahren zur Herstellung von Cyclooctaamylos. Ger Patent DE 33,17,064.
- _____. (1986) Production, Characterization and Application of Cyclodextrins. Adv. Biotech. Proc. 6 : 31-71.
- Bender, M.L., Komiyama, M. (1978) Cyclodextrin Chemistry Spring-Verlog, Heidelberg and New York : 2-9.
- Ben-Gershom, E. and Leibowitz, J. (1958) Enzymologia 20 : 133-147.
- Benshop, H.P., Van den Berg G.R. (1970) Sterospecific inclusion in cycloamyloses : Partial resolution of isopropyl methylphosphinate and related compounds. Chem. Commun. : 1431.
- Bradford, M.M. (1976) A rapid and sensitive method for the quantitatively of microgram quantities of protein utilizing the principle of protein-dye binding. Anal.Biochem 72 : 248-254.
- Breslow, R. (1984) Enzyme models related to inclusion compounds. Inclusion Compd. 3 : 473.
- Casu, B., Reggiani M. (1979) Methylated cycloamyloses and their inclusion properties. Carbohydr. Res. 76 : 59.
- * Cyclodextrin News (1987) CD polymers (June) 1(8) : 3.
- _____. (1991) Cholesterol Removal with CDs (May) 5(9) : 1-2.
- David, M.H., Gunther, H. and Roper, H. (1987) Starch/Starke 39 : 436-440.
- De Mot, R. and Verachtert, H. (1985a) Can. J. Microbiol. 32 : 47-51.
- _____. (1985b) App. Environ. Microbiol. 50 : 1474-1482.

- Depinto, J.A. and Campbell, L.L. (1968) Purification and Properties of Cyclodextrinase of *Bacillus macerans*. Biochemistry 7 : 121-125.
- Englbrecht, A., Harrer, G., Lebert, M., and Schid, G. (1990) Biochemical and genetic characterization of cyclodextrin glycosyltransferase from an alkalophilic bacterium forming primarily cyclodextrin. In D. Duchene (ed.), Proceeding of the Fifth International Symposium on Cyclodextrin : 25-31. Paris: Edition de Sante.
- Ensuiko. (1994) Stabilization of Natural Colors by Cyclodextrin. Japan
(Mimeo graphed).
- _____. (1994) Information of various cyclodextrin products. Japan
(Mimeo graphed).
- Flaschel, E., Landert, J. P., Renken A. (1982) Process development for the production of alpha-cyclodextrin. In J. Szejtli (ed.), Proc. Int. Symp. Cyclodextrin 1st Budapest : 41.
- French, D., Levine, M.L., Pazur J.H., Norberg, E. (1949) Studies on the Schardinger dextrans :The preparation and solubility characteristics of alpha-, beta- and gamma-dextrans. J. Am. Chem. Soc. 71: 353.
- _____. and Rundle R. E. (1942) The molecular weights of the Schardinger alpha and beta dextrin. J. Am. Chem. Soc. 64 : 165
- Freudenberg, K., Cramer, F. (1948) Die Konstitution der Schardinger Dexrin alpha, beta and gamma. Z Naturforsh B 3 : 464.
- Fuwa, H. (1954) A new method for microdetermination of amylase activity by the use of amylase as the substrate. J. Biochem. 41 : 583-603.
- Green, D.E. and Stump, P.K. (1942) J. Biol. Chem. 142 : 355.
- Hashimoto, H., Hara, K. and Kuwahara, N. (1985) : Denpun kakaku 32 : 312.

- _____, Hara, K. and Kuwahara, N. (1986) Denpun Kakaku 33 : 10.
- _____, Hara, K. and Kuwahara N. (1986) Industrial production of cyclodextrins VI
The continuous reaction of cyclodextrins formation by the column method
using the immobilized enzyme on ion-exchange resins. J. Jpn. Soc. Starch
Sci. 33 (1) : 29-33.
- Horikoshi, K. (1971) Production of alkaline enzymes by alkalophilic microorganisms.
Agric. Biol. Chem. 35 : 1783 - 1791.
- _____. (1979) Proc. Biochem 14 : 26 - 30.
- _____. (1988) Enzymology and molecular genetic of CD-forming enzyme.
Proc. 4th Int. Symp. Cyclodextrins : 7 - 17.
- _____, Ando, T., Yoshida, K., Tokyo J.P., Nakamura, N., Kunitachi, N. (1982)
Enzeugung von Cyclodextrin. Ger Patent DE 24, 53, 860.
- _____, and Akiba, T. (1982) Alkalophilic Microorganisms : A New Microbial
World. Japan Tokyo : Scientific Societies Press : 105 -157.
- _____, Yamamoto, M., Nakamura N., and Kawano M. (1981) U.S. Patent
4, 303, 787.
- _____, Yamamoto, M., Nakamura, N., Okada, M., Matsuzawa, M.,
Ueshima, O., Nakakuki, T. (1981) Process for producing Cyclodextrins.
Eur Patent EP.
- Kato, K., Sugimoto, T., Amemura, A. and Harada, T. (1975) Biochem. Biophys.
Acta. 391 : 96-108.
- Kato, T. and Horikoshi, K. (1984). Immobilized Cyclomaltodextrin glucanotransferase
of an alkalophilic *Bacillus* sp. No.38 - 2. Biotechnol.Bioeng. 26 : 595 - 598.

- Kitahata, S., and Okada, S. (1974) Action of Cyclodextrin Glycosyltransferase from *Bacillus megaterium* Strain No.5 on Starch. Agric. Biol. Chem. 28 : 2413-2417.
- _____, and Okada, S. (1975) Transfer action of cyclodextrin glycosyltransferase on starch. Agric. Biol. Chem. 39 : 2195.
- _____, and Okada, S. (1982a) Purification and properties of the cyclodextrin glycosyltransferase from *Bacillus stearothermophilus* TC-60. Dempun Kagaku 29 : 7 - 12.
- _____, and Okada, S. (1982b) Comparision of action of cyclodextrin glycosyltransferase from *Bacillus megaterium*, *B. circulans*, *B. stearothermophilus* and *B. macerans*. Denmpun Kagaku 29 : 13.
- _____, Okada, S. and Fukai, T. (1978) Acceptor specificity of transglycosylation catalyzed by cyclodextrin glucosyltransferase. Agric. Biol. Chem. 42 : 2369-2374.
- _____, Taniguchi, M., Beltran S.D., Sugimoto T., and Okada, S. (1983) Agric. Biol. Chem. 47 : 1441-1447.
- _____, Tsuyama N., Okada, S. (1974) Purification and some properties of the cyclodextrin glycosyltransferase from a strain of *Bacillus* species. Agric. Biol. Chem. 38 : 387-393.
- Kobayashi, S., Kainuma, K. and Suzuki, S. (1977) Purification and Properties of the CGTase from *B. macerans*. Jpn. Kokai 77, 79, 039 (C.A. 87 : 150201).
- Kuttiarcheewa, W. (1994) Immobilization of cyclodextrin glycosyltransferase on inorganic carriers. Master's Thesis, Faculty of Science, Chulalongkorn University.

- Lin, S.Z., Wouessidjewe D., Darrouzet H., Benita S. and Duchena D. (1990) In vitro Release Examination of Indomethacin from Indomethacin / β -cyclodextrin and Indomethacin / hydroxypropyl β - cyclodextrin complexes In D. Duchene (ed.), Minutes of the fifth International Symposium on Cyclodextrins. : 341 - 345.
- Matsuda H., Ito K., Tanaka M., Uekawa K. (1994) Application of 2 -hydroxypropyl - β -cyclodextrin to perfumes and cosmetics. In T. Osa (ed.), Proceedings of the seventh International Symposium on cyclodextrins : 516 - 519.
- Matzuzawa , M., Nakamura, N. and Horikoshi, K. (1975) Starch / Starke 27 : 410.
- Mikolajczek, M., Drabowicz, J. (1978) Optical resolution of chiral sulfinyl compounds via beta - cyclodextrin inclusion complexes. J. Am. Chem. Soc. 100 : 2510.
- Miskolci-Török, M., Seress, L., Vakalin, H., Szejtli, J., Jaria, M. (1980) : Cyclodextrin-glucosyltransferase enzyme. Hung Patent 17, 926
- Moseley, M. H. and Keay, L. (1970) Biotechnol. Bioeng. 12 : 251-271.
- Nakamura, N. and Horikoshi K. (1976) Purification and Properties of Cyclodextrin Glycosyltransferase of an Alkalophilic *Bacillus* sp. Agric. Biol. Chem. 40(5) : 935-941.
- _____ and Horikoshi, K. (1976). Characterization and some cultural conditions of a CGTase-producing alkalophilic *Bacillus* sp. Agric. Biol. Chem. 40 : 753 - 757.
- _____ and Horikoshi, K. (1977) Production of schardinger β - dextrin by soluble and immobilized cyclodextrin glycosyltransferase of an alkalophilic *Bacillus* sp. Biotech & Bioeng. 19 : 87 - 99.

- Nagatomo, S. (1985) Cyclodextrins-Expanding the development of their functions and applications. Chem. Econ. Eng. Rev. 17 : 28 - 34.
- Nelson, N. (1944) A Photometric Adaptation of the Somogyi Method for the determination of glucose. J. Bio. Chem., 153 : 375-380.
- Nihon Shokuhin Kako (1987) Celdex : Cyclodextrins Japan (Mimeographed).
- Nomoto, M., Chen, C.C, and Sheu, D.C. (1986) Purification and characterization of cyclodextrin glucanotransferase from alkalophilic bacterium of Taiwan. Agric. Biol. Chem. 50 : 2701 - 2707.
- Numata, C. (1970) Bachelor ' s Thesis, University of Okada Prefecture.
- Oguma, T., Kikuchi, M. and Mizusawa, K. (1990) Biochem. Biophys. Acta. 1036 : 1-5.
- Okada, M., Matsuzawa, M. and Uezima, O. (1983) U.S. Patent 4, 384, 898.
- Okada, S. and Kitahata, S. (1975) Method of Purification of Cyclodextrin Producing Enzyme US Patent 3, 888, 738.
- Pongsawasdi, P. and Yagisawa, M. (1987) Screening and Identification of a Cyclomaltodextrin Glucanotransferase Producing Bacteria, J. Ferment. Technol. 65 : 463 - 467.
- _____(1994) Research and new product development from tapioca. The Thai Tapioca Development Institute. (Mimeographed).
- Rojtinnakorn, J. (1994) Preparation of antibody against cyclodextrin glycosyltransferase from Bacillus A 11. Master's Thesis, Faculty of science, Chulalongkorn University.
- Rutchtorn, U. (1993) Production of cyclodextrin glucanotransferase in a fermenter and its immobilization on DEAE-cellulose. Master ' s Thesis, Faculty of Science, Chulalongkorn University.

- Saenger, W. (1979) Circular hydrogen bonds in alpha - cyclodextrin hexahydrate. Nature 279 : 343.
- _____. (1982) Structure Aspect of Cyclodextrin Inclusion Compounds , Proc. 1st Int. Symp. Cyclodextrins : 141 - 145.
- Saha, B.C., Mathupala S.P. and Zeikus J.G. (1988) J. Biochem 252 : 343-348.
- _____. and Zeikus J.G. (1990) Appl. Environ. Microbiol. 56 : 2941-2943.
- Seres, G. (1984) Acta Biochem. Biophys. Acad. Sci. Hung. 19 : 64.
- Schmid, G. (1989) Cyclodextrin glycosyltransferase production : yield enhancement by overexpression of cloned genes. Tibtech (September) 7 : 244 - 248.
- Szejtli, J. (1988) Chapter 1 : Cyclodextrin, Cyclodextrin Technology. Netherland : Kluwer Academic Publishers.
- _____. (1990) Cyclodextrins Properties and Application. Drug Invest. 2 (Suppl.4) : 11-21.
- Smith, S.P. (1982) Starch Derivatives and their use in foods , Food Carbohydrate. In R. D. Lineback and G. E. Inglett , (eds.) AVI Publishing : 237 - 269.
- Starnes, R.L., Flint V.M. and katkocin D.M. (1990) Cyclodextrin production with a highly thermostable cyclodextrin glycosyltransferase from *Thermoanaerobacter* sp. In D. Duchene (ed.), Minutes of the Fifth International Symposium on Cyclodextrins, Paris : 55-61.
- Steignardt, J. and Kleine R. (1993) Production and immobilization of a proteinase - reduced cyclodextrin glycosyltransferase preparation. Appl. Microbiol. Biotechnol. 39 : 63 - 68.
- Suetsugu, N., Koyama, S., Takao, K. and Kuge, T. (1974) J. Biochem 76 : 57-63.
- Sundararajan P.R., Rau V.S.R. (1970) Conformational studies on cycloamyloses. Carbohydr. Res. 13 : 351.

- Techaiyakul, W. (1991) Production and characterization of cyclodextrin glucanotransferase from *Bacillus* spp. Master's Thesis, Faculty of Science, Chulalongkorn University.
- _____
Pongsawasdi, P. and Mongkolkul, P. (1992) Purification and enzymatic properties of cyclodextrin glycosyltransferase from *Bacillus* A 11. In A. R. Hedges (ed.), Minutes of the 6th International Symposium on Cyclodextrins : 34 - 37.
- Tomohiro, E., Haruhis, U., Shoichi, K. and Tsuneji, N (1994) Purification and characterization of η - cyclodextrin. In T. Osa (ed.), Proceedings of the seventh International Symposium on Cyclodextrin : 66 - 69.
- Thoma J. A. and Koshland D.E. (1960) J. Am. Chem. Soc. 82 : 3329.
- Ueda H., Saijo T. and Nagai T. (1990) Enhancement of Anti - tumor activity of carmofur (HCFU) by Maltosyl (G_2) / β - cyclodextrin complexation in L - 1210 Leukemia-Bearing Mice. In D. Duchene (ed.), Minutes of the Fifth International Symposium on Cyclodextrins : 470 - 474.
- Vakaliu, H., Seres, G., Miskolczy-Torok, M., Szejtli, J., Jaray, M. (1977) Production of beta-cyclodextrin. Hung Patent 173, 825.
- Wacker (1994) Cyclodextrins and Derivatives. USA (Mimeographed).
- Yagi, Y., Iguchi, H. (1974) : Alpha-amylase production by *Bacillus ohbensis*. Jap Patent 74, 124,285.
- _____
Kouno, K., Juni, T. (1980) A process production cyclodextrins. Eur Patent 0, 017, 242.
- _____
Tanaka, Y. , and Inui, T. (1980) A process for producing Cyclodextrins. Dur Patent 0, 017, 242.

- Yamamoto M., Aritomi H., Irie T., Hirayama F. and Uekama K. (1990) Pharmaceutical Evaluation of Branched β -cyclodextrins as Parenteral Drugs Carriers. In D. Duchene (ed.), Minutes of the Fifth International Symposium on Cyclodextrins : 541 - 544.
- _____ Tanaka, Y., and Horikoshi, K. (1972) Alkaline amylases of alkalophilic bacteria. Agric. Biol. Chem. 36 : 1819 - 1823.
- Lee Y. D. and Kim H. S. (1991) Enhancement of enzymatic production of cyclodextrins by organic solvents. Enzyme Microb. Technol. 13 : 499-503.

APPENDICES

APPENDIX A : Buffer for Purification of enzyme CGTase

1) 10 mM Tris-HCl buffer with 10 mM CaCl₂ , pH 8.5 (TB)

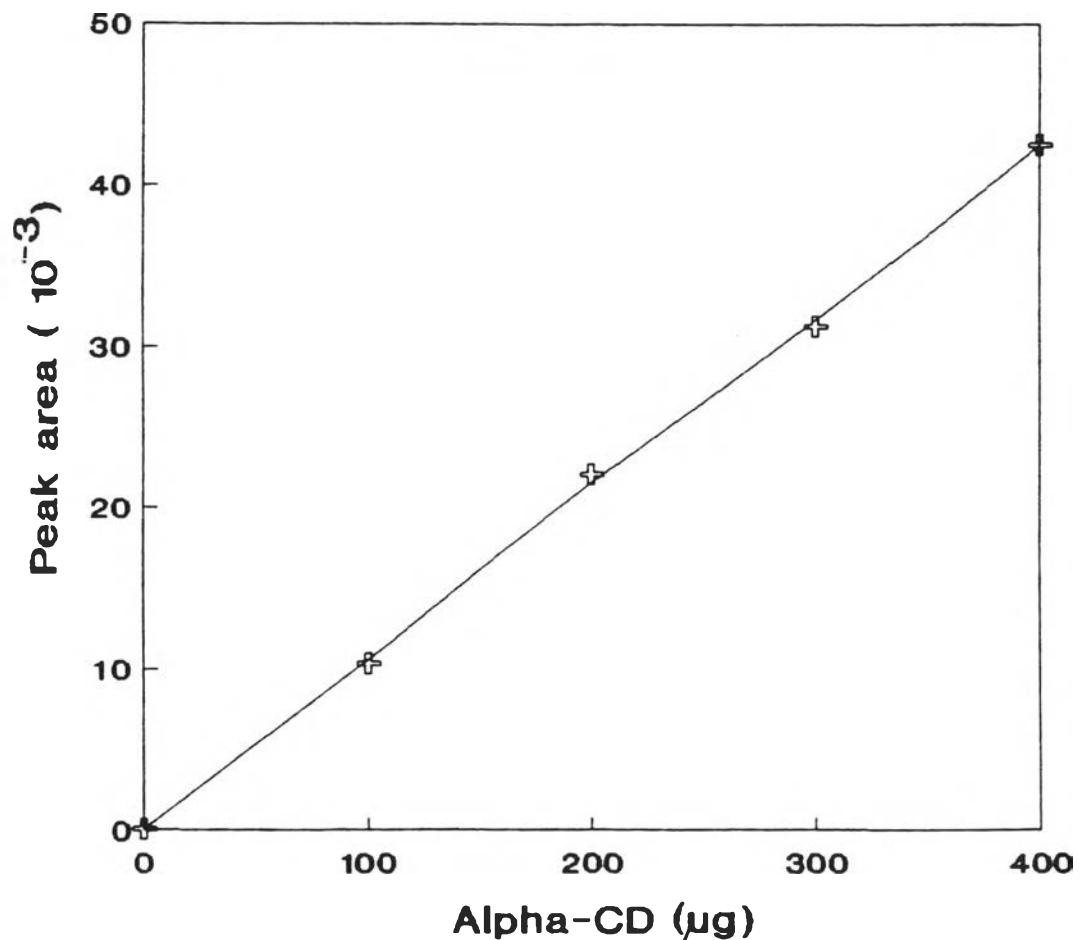
Tris (hydroxymethyl)-aminomethane	1.21 g
CaCl ₂ · 2 H ₂ O	1.47 g

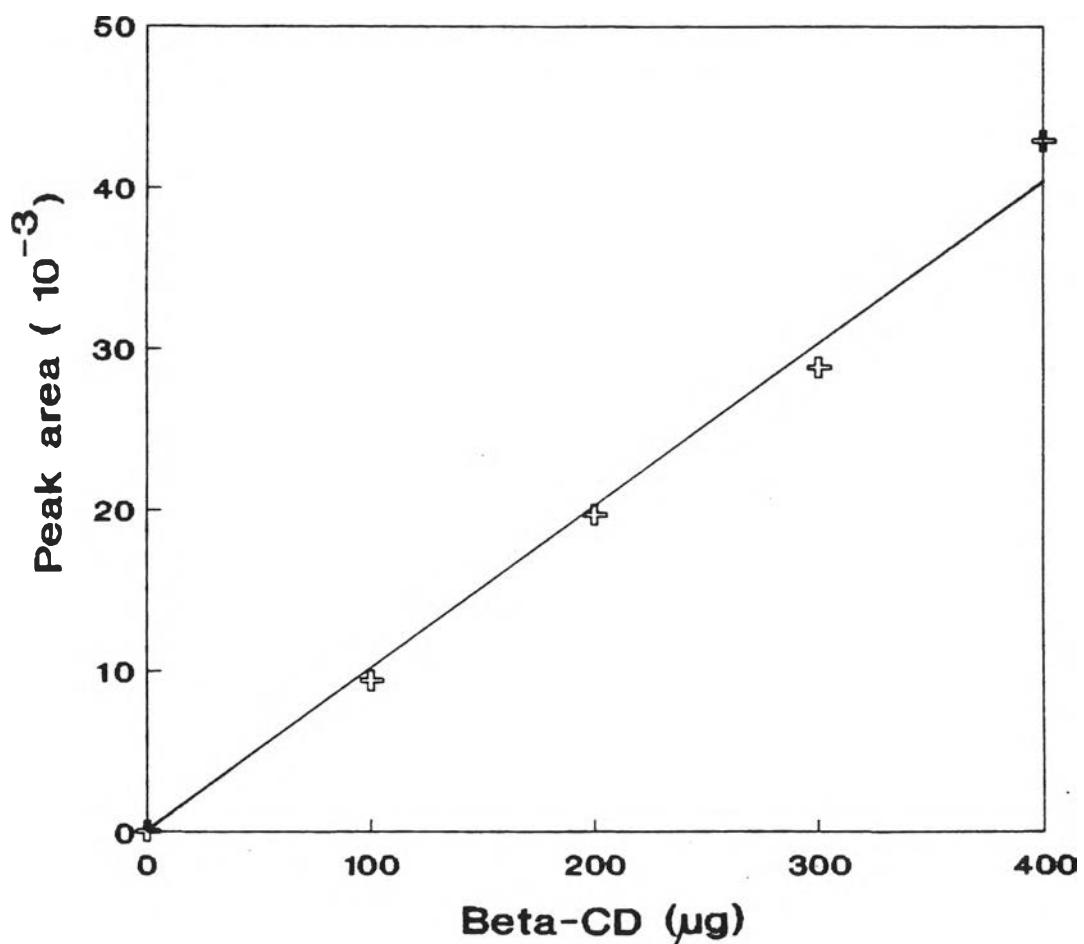
Adjust pH to 8.5 with HCl and final volume to 1 litre.

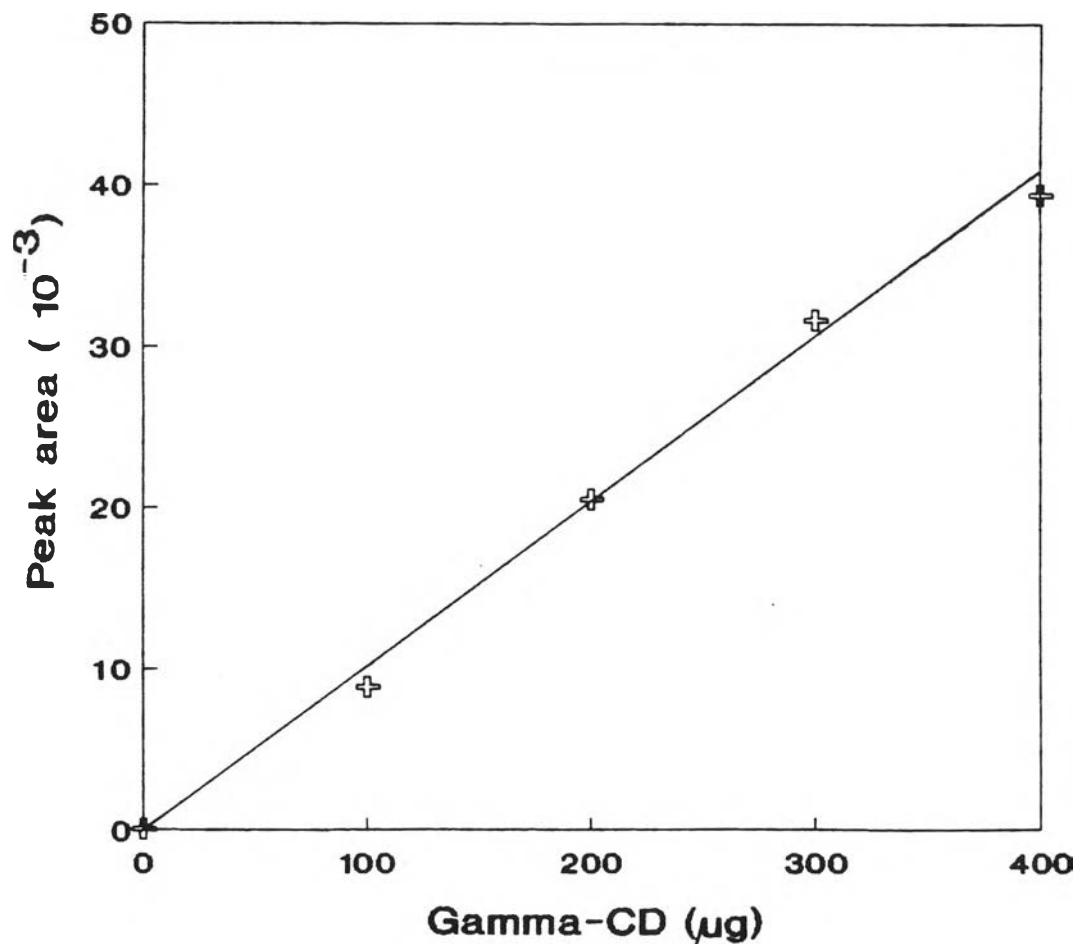
2) 50 mM Sodium acetate buffer with 5 mM CaCl₂ , pH 6.0 (SB)

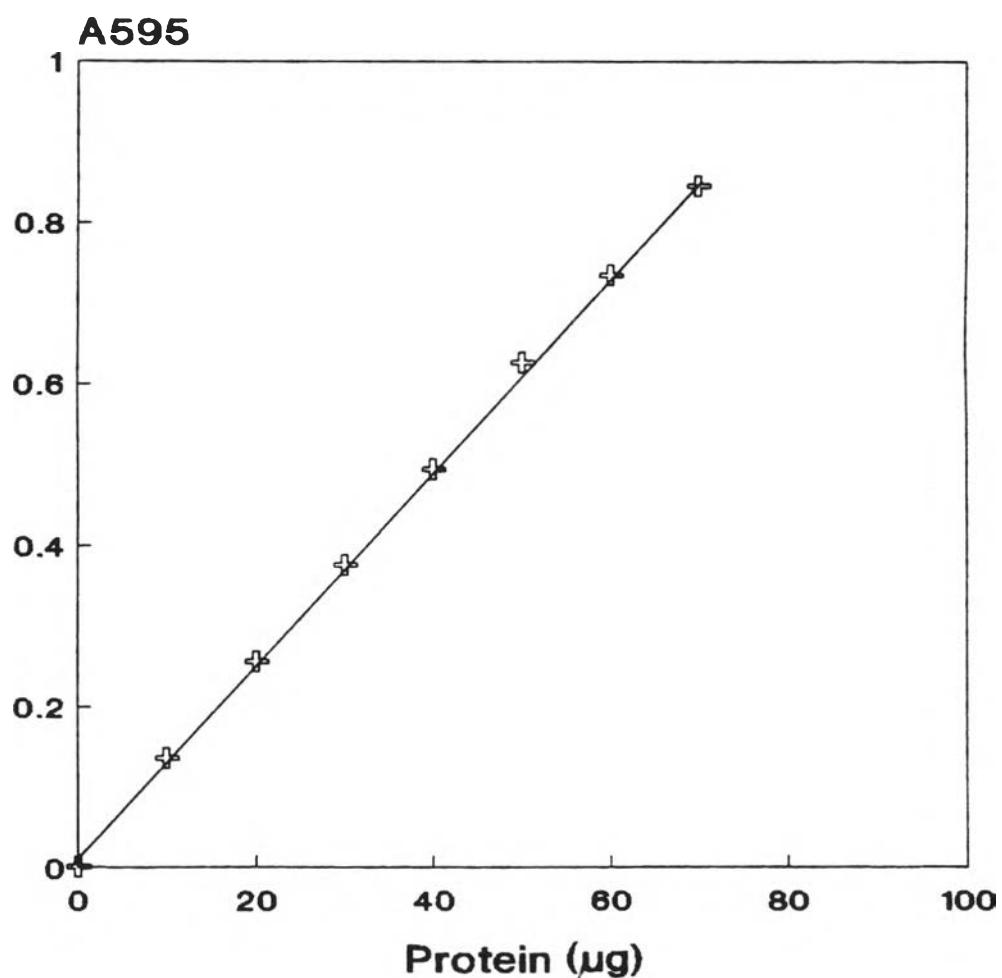
Sodium Acetate	4.10 g
CaCl ₂ · 2 H ₂ O	0.74 g

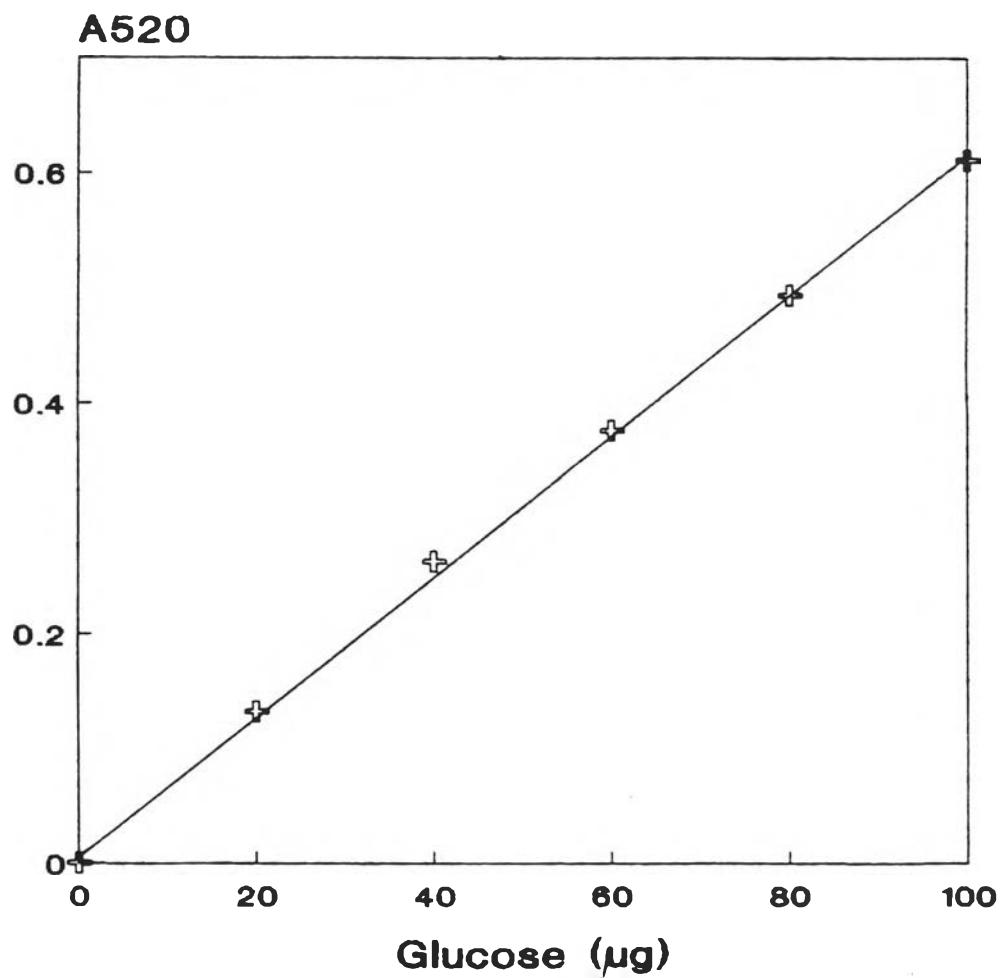
Adjust pH to 6.0 with Acetic acid and final volume to 1 litre.

APPENDIX B : Standard curve of α -CD (by HPLC)

APPENDIX C : Standard curve of β -CD (by HPLC)

APPENDIX D : Standard curve of γ -CD (by HPLC)

APPENDIX E : Standard curve of protein (by Bradford's method)

APPENDIX F : Standard curve of glucose (by Nelson Somogyl' s method)

BIOGRAPHY

Miss Tipsupar Malai was born on January 3rd, 1971. She graduated with the Bachelor Degree of Science in Biochemistry from Chulalongkorn University in 1991 and continued studying for Master course in Biotechnology Program with the two year-Research Assistantship from the Graduate School & Research Affairs Section, Chulalongkorn University.

