

บรรณานุกรม

- ณรงค์ โฉมเฉลา. (2554). มหัศจรรย์น้ำมันมะพร้าว, กรุงเทพ. โพสต์บุ๊กส์.
- Aiken, J.E. (2006). Purification of glycerin, US Patent. 7,126,032B1.
- Asher, D.R. & Simpson, D.W. (1956). Glycerol purification by ion exclusion, *J. Phys. Chem.* 60: 518-521.
- Attanatho, L., Magmee, S. & Jenvanitpanjakul, P. (2004). Factors affecting the synthesis of biodiesel from crude palm kernel oil, In : The Joint International Conference on “Sustainable Energy and Environment (SEE)”. Hua Hin, Thailand. 359-361.
- Bergsson, G., Arnfinnsson, J., Steingrimsson, O. & Thormar, H. (2002a). Killing of gram-positive cocci by fatty acids and monoglycerides, *APMIS*. 109 : 670-678.
- Bornscheuer, U.T. (1995). Lipase-catalyzed synthesis of monoacylglycerols, *Enzyme Microb. Technol.* 17 : 578-586.
- Bornscheuer, U.T. & Yamane, T. (1994). Activity and stability of lipase in the solid-phase glycerolysis of triolein, *Enzyme Microb. Technol.* 16 : 864-869.
- Brockhoff, H. & Jensen, R.G. (1974). Lipase, in : Lipolytic Enzyme, Academic Press, New York. pp. 32-34.
- Brockmann, R., Jeromin, L., Johannsbauer, W., Meyer, H., Michel, O. & Plachenka, J. (1987). Glycerol distillation process, US Patent. 4,655,879.
- Caro, Y., Villeneuve, P., Pina, M., Reynes, M. & Graille, J. (2000). Investigation of crude latex from various *Carica papaya* varieties for lipid bioconversions, *J. Am. Oil Chem. Soc.* 77: 891-901.
- Chi, Z., Pyle, D., Wen, C., Frear, C. & Chen, S. (2007). A laboratory study of producing docosahexaenoic acid from biodiesel-waste glycerol by micro algal fermentation, *Process. Biochem.* 42: 1537-1545.
- Chiu, C.W., Dasari, M.A., Sutterlin, W. R., & Suppes, G.J. (2006). Removal of residual catalyst from simulated biodiesel's crude glycerol for glycerol hydrogenolysis to propylene glycol, *I & EC Research.* 45: 791-795.

- Damstrup, M.L., Jensen, T., Sparso, F.V., Kiil, S.Z., Jensen, A.D. & Xu, X. (2005). Solvent optimization for efficient enzymatic monoacylglycerol production based on a glycerolysis reaction, *J. Am. Oil Chem. Soc.* 82: 559-564.
- Dasari, M.A., Kiatsimkul, P.P., Sutterlin, W.R. & Suppes, G.J. (2005). Low-pressure hydrogenolysis of glycerol to propylene glycol, *Appl. Catal. A.* 281: 225-231.
- Dayrit, C.S. (2000). Coconut oil in health and disease: Its monolaurin potential as cure for HIV/AIDs, XXXVII Cocotech Meeting, Chennai, India.
- Elfman-Borjesson, I. & Harrod, M. (1999). Synthesis of monoglycerides by glycerolysis of rapeseed oil using immobilized lipase, *J. Am. Oil Chem. Soc.* 76: 701-707.
- Enig, M.G. (1998). Lauric oils as antimicrobial agents: theory of effect, scientific rationale, and dietary application as adjunct nutritional support for HIV-infected individuals. In: "Nutrients and Foods," (Watson RR, ed.) CRC Press, Boca Raton, pp. 81-97.
- Ferreira-Dias, S. & Fonseca, M.M.R. (1995). Production of monoglyceride by glycerolysis of olive oil with immobilized lipase: effect of the water activity, *Bioproc Biosyst Eng.* 1995: 327-337.
- Fukuda, H., Kondo, A. & Noda, H. (2001). Biodiesel fuel production by transesterification of oils, *J. Biosci. Bioeng.* 92: 405-416.
- Fukui, T., Kawamoto, T., Sonomoto, K. & Tanaka, A. (1990). Long-term continuous production of optically active 2-(4-chlorophenoxy) propanoic acid by yeast lipase in an organic solvent system, *Appl. Microbiol. Biotechnol.* 34: 330-334.
- Gandhi, N.N. (1997). Application of lipase, *J. Am. Oil Chem. Soc.* 74: 621-634.
- Garcia, H.S., Yang, B. & Parkin, K.L. (1996). Continuous reactor for enzymatic glycerolysis of butter oil in the absence of solvent, *Food Res. Int.* 28: 605-609.
- Giordani, R., Moulin, A. & Verger, R. (1991). Tributyrylgllycerol hydrolase activity in *Carica papaya* and other lattices, *Phytochem.* 30: 1069-1072.
- H-Kittikun, A., Kaewthong, W. & Cheirsilp, B. (2008). Continuous production of monoacylglycerols from palm olein in packed-bed reactor with immobilized lipase PS, *Biochem. Eng. J.* 40: 116-120.
- Hoogendoorn, A., Adriaans, T., Kasteren, J.M.N. and Jayaraj, K.M. (2007). Glycerin purification via bio-catalysis and column adsorption for high-quality application, *Report nr. 0656632-R06.*

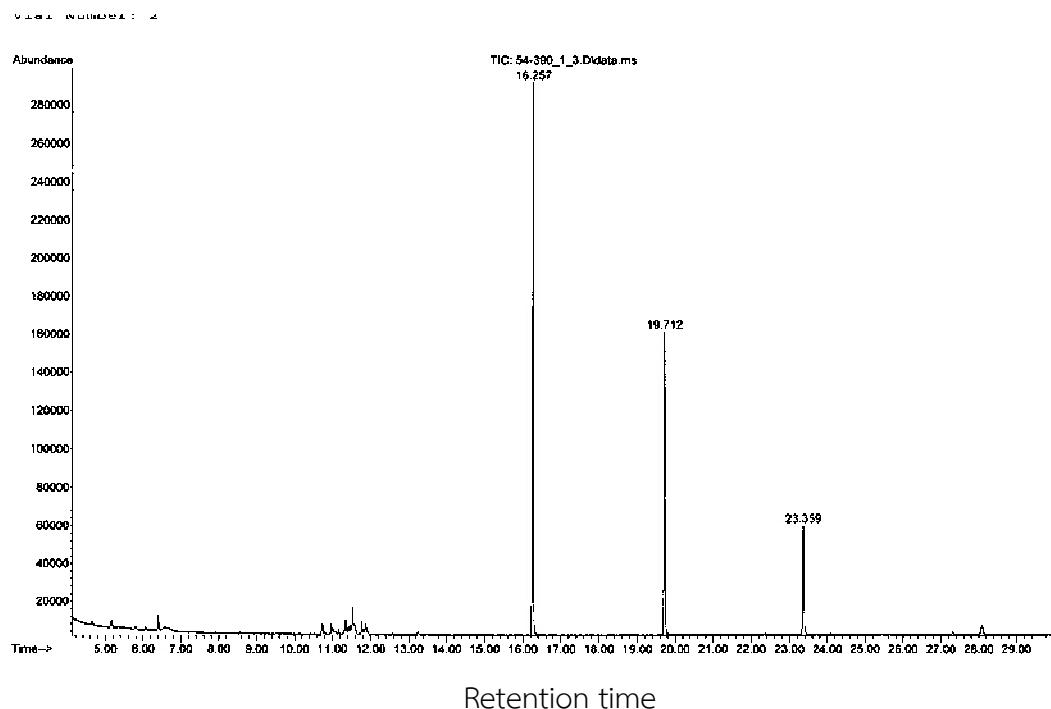
- Houde, A., Kademi, A. & Leblanc, D. (2004). Lipase and their industrial applications: an overview, *Appl Biochem Biotechnol.* 118: 155-170.
- Jackson, M.A. & King, J.W. (1997). Lipase-catalyzed glycerolysis of soybean oil in supercritical carbon dioxide, *J. Am. Oil Chem. Soc.* 74 : 103-106.
- Jacobsen, T. & Poulsen, O.M. (1992). Separation and characterization of 61- and 57-kDa lipases from *Geotrichum candidum* ATCC 66592, *Can. J. Microbiol.* 38: 75-80.
- Kaewthong, W. & H-Kittikun, A. (2004). Glycerolysis of palm olein by immobilized lipase PS in organic solvents, *Enzyme Microb. Technol.* 35: 218-222.
- Kaewthong, W., Sirisansaneeyakul, S., Prasertsan, P. & H-Kittikun, A. (2005). Continuous production of monoacylglycerols by glycerolysis of palm olein with immobilized lipase, *Process Biochem.* 40: 1525-1530.
- Kennedy, J.F. & Cabral, J.M.S. (1987). Enzyme immobilization, In *Biotechnology*. Vol.7a *Enzyme Technology*. (Kennedy, J.F., ed.). p. 347-404. VCH Publishers. New York.
- Krijgsman, J. (1992). Product recovery in bioprocess technology, Butterworth-Heinemann. Oxford.
- Kwon, S.J., Han, J.J. & Rhee, J.S. (1995). Production and in situ separation of mono- or diacylglycerol catalyzed by lipase in n-hexane, *Enzyme Microb. Technol.* 17: 700-704.
- Lee, G-L., Wang, D-L., Ho, Y-F. & Shaw, J-F. (2004) Lipase-catalyzed alcoholysis of triglycerides for short-chain monoglyceride production, *J. Am. Oil Chem. Soc.* 81 : 533-536.
- Li, Z.Y. & Ward, O.P. (1993). Lipase-catalyzed esterification of glycerol and N-3 polyunsaturated fatty acid concentrate in organic-solvent, *J. Am. Oil Chem. Soc.* 70: 745-748.
- Linko, Y.Y., Lämsä, M., Wu, X., Uosukainen, E., Seppälä, J., & Linko, P. (1998). Biodegradable products by lipase biocatalysis, *J. Biotechnol.* 66: 41-50.
- Lithauer, D., Ginster, A. & Skein, E.V.E. (2002). *Pseudomonas luteola* lipase: a new member of the 320-residue *Pseudomonas* lipase family, *Enzyme Microb Technol.* 30: 209-215.
- Macrae, A.R. & Hammond, R.C. (1985). Present and future applications of lipases, *Biotech. Genet. Eng. Rev.* 3: 193-217.

- Maria, P.D., Sivisterra, J.V., Tsai, S-W & Alcantara, A.R. (2006). *Carica papaya* lipase (CPL): An emerging and versatile biocatalyst, *Biotechnol. Adv.* 24: 493-499.
- Marzo, A., Ghirardi, P., Sardini, D. & Meroni, G. (1971). Simplified measurement of monoglycerides, diglycerides, triglycerides and free fatty acids in biological samples, *Clin. Chem.* 17 : 145-147.
- McEvily, A.J. & Zaks, A. (1991). Emulsifiers and Surfactants, In Biotechnology and Food Ingredients, (Goldberg, I. and Williams, R., eds.). p. 193-209. Van Nostrand Reinhold. New York.
- McNeill, G.P. & Yamane, T. (1991). Further improvements in the yield of monoglycerides during enzymatic glycerolysis of fats and oils, *J. Am. Oil Chem. Soc.* 68: 6-10.
- McNeill, G.P., Shimizu, S. & Yamane, T. (1990). Solid phase enzymatic glycerolysis of beef tallow resulting in a high yield of monoglyceride, *J. Am. Oil Chem. Soc.* 67: 779-783.
- Miller, C., Austin, H., Posorske, L. & Gonzlez, J. (1988). Characteristics of an immobilized lipase for the commercial synthesis of ester, *J. Am. Oil Chem. Soc.* 65: 927-931.
- Moussaoui, A.El., Nijs, M., Paul, C., Wintjens, R., Vincentelli, J., Azarkan, M. & Looze, Y. (2001). Revisiting the enzymes stored in the laticifers of *Carica papaya* in the context of their possible participation in the plant defence mechanism, *Cell. Mol. Life Sci.* 58: 556-570.
- Mukherjee, K.D. & Kiewitt, I. (1996). Specificity of *Carica papaya* latex as biocatalysts in the esterification of fatty acids with 1-butanol, *J. Agric. Food Chem.* 44: 1948-1952.
- Nawar, W.W. (1996). Lipids. In "Food Chemistry," 3rd ed. (Fennema, O.R. ed.) Marcel Dekker, Inc., New York, pp. 225-319.
- Padt, A., Keurentjes, J.T.F., Sewalt, J.J.W., van Dam, E.M., van Dorp, L.J. & van't Riet, K. (1992). Enzymatic synthesis of monoglycerides in a membrane bioreactor with an in-line adsorption column, *J. Am. Oil Chem. Soc.* 69: 748-754.

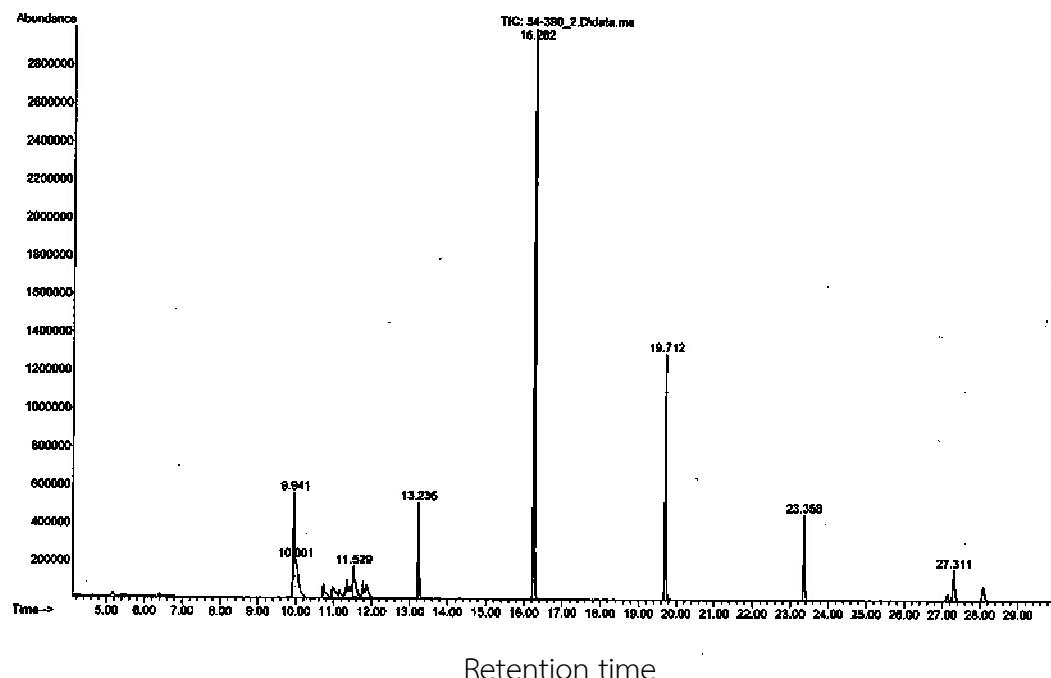
- Qingsheng, Li., Estes, J.D., Schlievert, P.M., Duan, L., Brosnahan, A.J., Southern, P.J., Reilly, C.S., Peterson, M.L., Schultz-Darken, N., Brunner, K.G., Nephew, K.R., Pambuccian, S., Lifson, J.D., Carlis, J.V. & Haase, A.T. (2009) Glycerol monolaurate prevents mucosal SIV transmission, *Nature*. 458: 1034-1040.
- Rathi, P., Saxena, R.K. & Gupta, R. (2001). A novel alkaline lipase from *Burkholderia cepacia* for detergent formulation, *Process Biochem.* 37: 187-192.
- Rosu, R., Uozaki, Y., Iwasaki, Y. & Yamane, T. (1997). Repeated use of immobilized lipase for monoacylglycerol production by solid-phase glycerolysis of olive oil, *J. Am. Oil Chem. Soc.* 74: 445-450.
- Sonntag, N.O.V. (1982). Glycerolysis of fats and methyl esters-status, review and critique, *J. Am. Oil Chem. Soc.* 59: 795A-802A.
- Stevenson, D.E., Stanley, R.A. & Furneaux, R.H. (1993). Glycerolysis of tallow with immobilized lipase, *Biotechnol. Lett.* 15: 1043-1048.
- Temelli, F., King, J.W. & List, G.R. (1996). Conversion of oils to monoglycerides by glycerolysis in supercritical carbon dioxide media, *J. Am. Oil Chem. Soc.* 73: 699-706.
- Thude, S., Shukun, L., Said, M.B. & Bornscheuer, U.T. (1997) Lipase-catalyzed synthesis of monoacylglycerides by glycerolysis of camphor tree seed oil and cocoa-butter, *Fett. Lipid.* 99: 246-250.
- Torres, C., Lin, B. & Hill, Jr.C.G. (2002). Lipase-catalyzed glycerolysis of an oil rich in eicosapentaenoic acid residues, *Biotechnol. Lett.* 24: 667-673.
- Tuter, M. & Aksoy, H.A. (2000). Solvent-free glycerolysis of palm and palm kernel oils catalyzed by commercial 1,3-specific lipase from *Humicola Lanuginosa* and composition of glycerolysis products, *Biotechnol. Lett.* 22: 31-34.
- Vaysse, L., Ly, A., Moulin, G. & Dubreucq, E. (2002). Chain-length selectivity of various lipases during hydrolysis, esterification and alcoholysis in biphasic aqueous medium, *Enzyme Microb. Tech.* 31: 648-655.
- Villeneuve, P., Pina, M., Montet, D. & Graille, J. (1995). Determination of lipase specificity through the use of chiral triglycerides and their racemics, *Chem. Phys. Lipids.* 76: 109-113.

- Villeneuve, P., Pina, M., Skarbek, A., Graille, J. & Foglia, T.A. (1997). Specificity of *Carica papaya* latex in lipase-catalyzed interesterification reactions, *Biotechnol. Tech.* 11: 91-94.
- Villeneuve, P., Skarbek, A., Pina, M., Graille, J. & Foglia, T.A. (1997). Catalytic behavior of *Carica papaya* latex in transesterification reactions, *Biotechnol. Tech.* 11: 637-639.
- Xu, X. (2000). Production of specific-structured triacylglycerols by lipase-catalyzed reaction: a review, *J. Lipid Sci. Technol.* 102: 287-303.
- Yamane, T., Hoq, M.M., Itoh, S. & Shimizu, S. (1986). Glycerolysis of fat by lipase, *J. Jpn. Oil Chem. Soc.* 35: 625-631.
- Yamane, T., Kang, S.T., Kawahara, K. & Koizumi, Y. (1994). High-yield diacylglycerol formation by solid-phase enzymatic glycerolysis of hydrogenated beef tallow, *J. Am. Oil Chem. Soc.* 71: 339-342.
- Yang, B., Kuo, S-J., Hariyadi, P. & Parkin, K.L. (1994). Solvent suitability for lipase-mediated acyl-transfer and esterification reactions in microaqueous milieu is related to substrate and product polarities, *Enzyme Microb. Technol.* 16: 577-583.
- Zhong, N., Li, L., Xu, X., Cheong, L., Li, B., Hu, S. & Zhao, X. (2009). An efficient binary solvent mixture for monoacylglycerol synthesis by enzymatic glycerolysis, *J. Am. Oil Chem. Soc.* 86: 783-789.
- Zhou, D., Xu, X., Mu, H., Hoy, C. & Adler-Nissen, J. (2001). Synthesis of structured triacylglycerols containing caproic acid by lipase-catalyzed acidolysis: Optimization by response surface methodology, *J. Agr. Food Chem.* 49: 5771-5777.

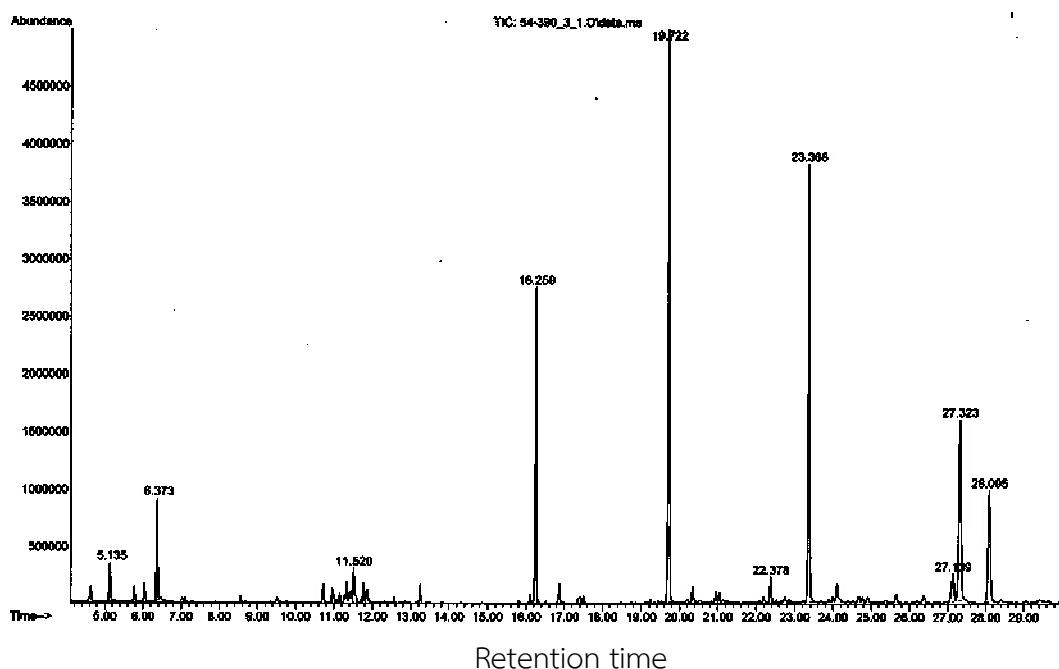
ภาคผนวก ก
โครงมาตรากรัมของไตรกลีเซอไรด์ที่เหลือจากปฏิกิริยากลีเซอโรไลซิส



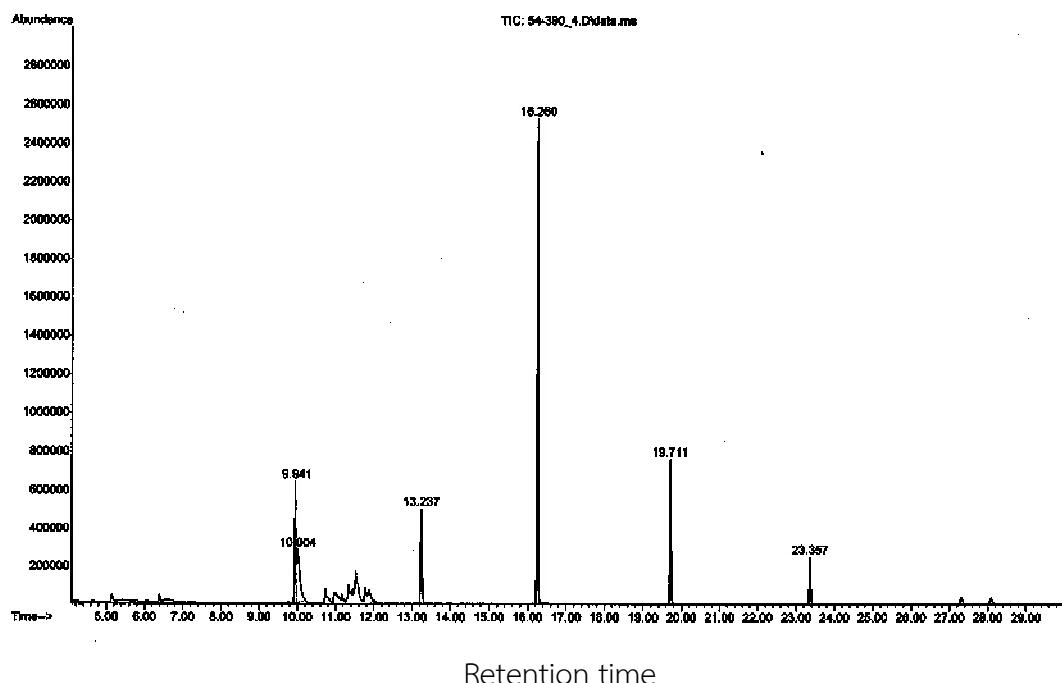
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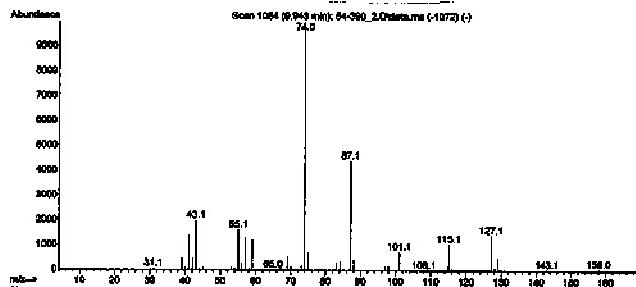
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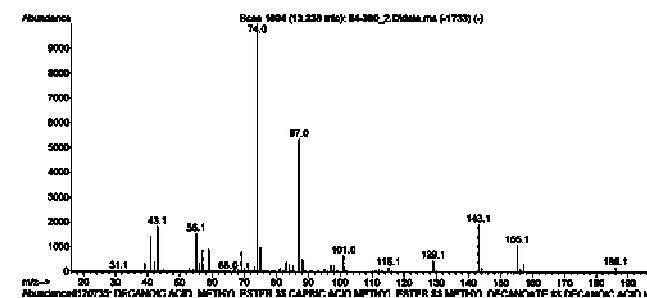
ภาคผนวก ง
โครโนโตรแกรมของกรดไขมันที่เกิดขึ้นจากปฏิกิริยากลีเซอโรไลซีส



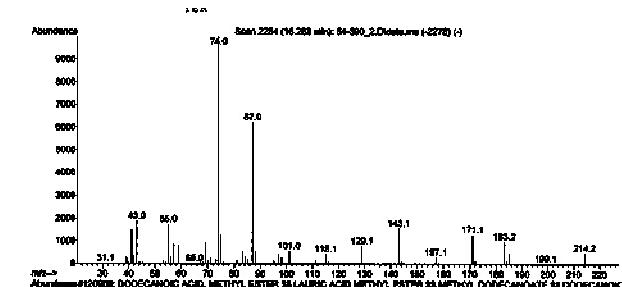
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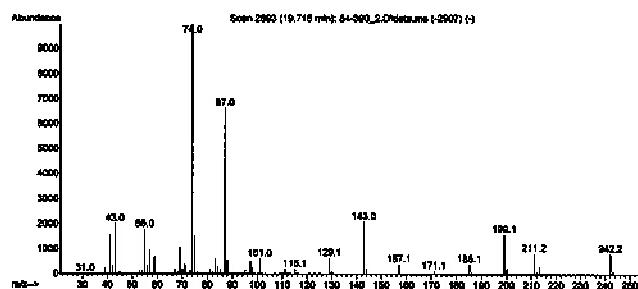
Peak ที่ 11 Retention Time = 9.943



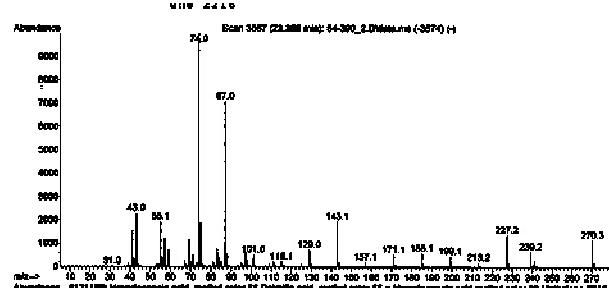
Peak ที่ 12 Retention Time = 13.238



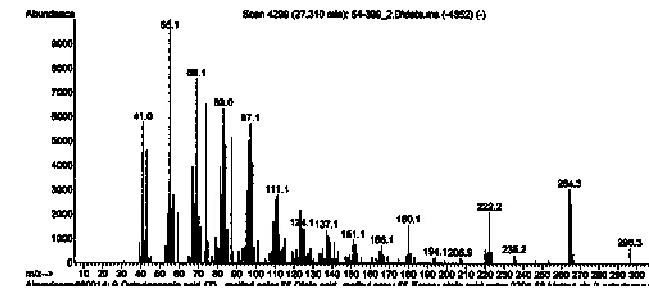
Peak ที่ 13 Retention Time = 16.263



Peak ที่ 14 Retention Time = 19.715



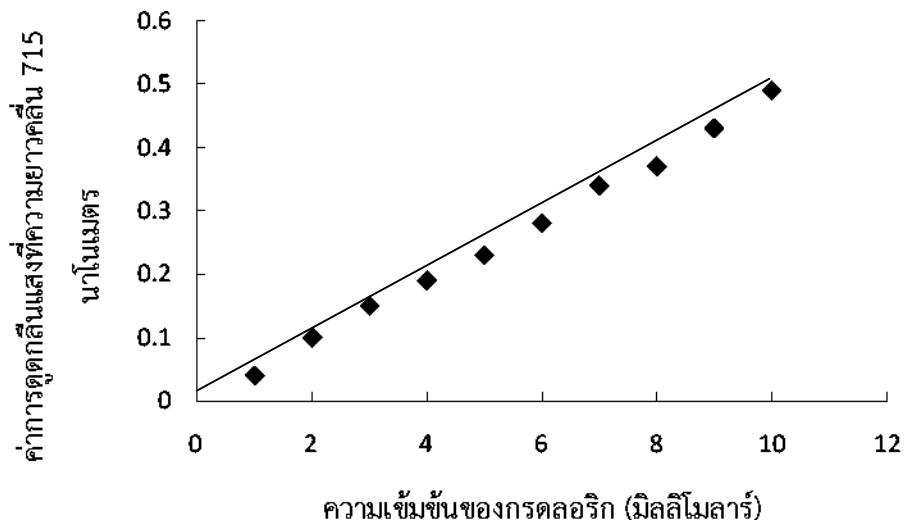
Peak ที่ 15 Retention Time = 23.356



Peak ที่ 16 Retention Time = 27.310

ภาคผนวก ฉ

กราฟมาตรฐานของกรดลอริก



ภาคผนวก ช

กราฟมาตรฐานของกลีเซอไรด์แต่ละชนิด

