APPENDIX

Appendix A

Determination of lipase activity by titrimetric method

$$\text{Activity of lipase (u/g)} = \frac{A \times B \times 10^6}{1000 \times C \times 60}$$

where A = concentration of NaOH (M)

B = V_{NaOH} sample (ml) – V_{NaOH} blank (ml)

C = weight of lipase (g)

Appendix B

Determination of lipase activity by colorimetry

1. Standard curve for determination of lipase activity by colorimetry.

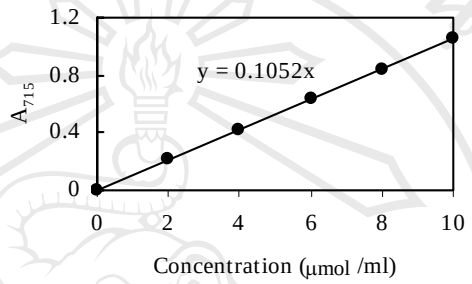


Figure B1 Standard curve of oleic acid.

2. Calculation of lipase activity

$$\text{Activity of lipase (u/g)} = \frac{B}{A \times 60}$$

where A = weight of lipase (g)

B = μmol of oleic acid from hydrolysis reaction

Appendix C

Retention time of substrates and products in methanolysis of triolein or palm oil

Table C1 Retention time of tri-, di- and monoacylglycerols, esters and free fatty acids from chromatogram analyzed by GC.

Substrate and product	Retention time (min)
Trimyristin	15.1
Tripalmitin	17.6
Triolein	23.7
Tristearin	24.1
Methyl myristate	1.6
Methyl palmitate	2.5
Methyl oleate	3.9
Methyl stearate	4.0
Ethyl myristate	1.8
Ethyl palmitate	3.1
Ethyl oleate	4.0
Ethyl stearate	4.4
Butyl stearate	6.2
Myristic acid	1.9
Palmitic acid	2.9
Oleic acid	4.5
Stearic acid	4.6
Diacylglycerols	12.5, 13.6, 14.4, 14.6
Monoacylglycerols	8.6, 8.8, 9.7, 9.9

Appendix D

Standard curves of methyl esters for determination of product contents

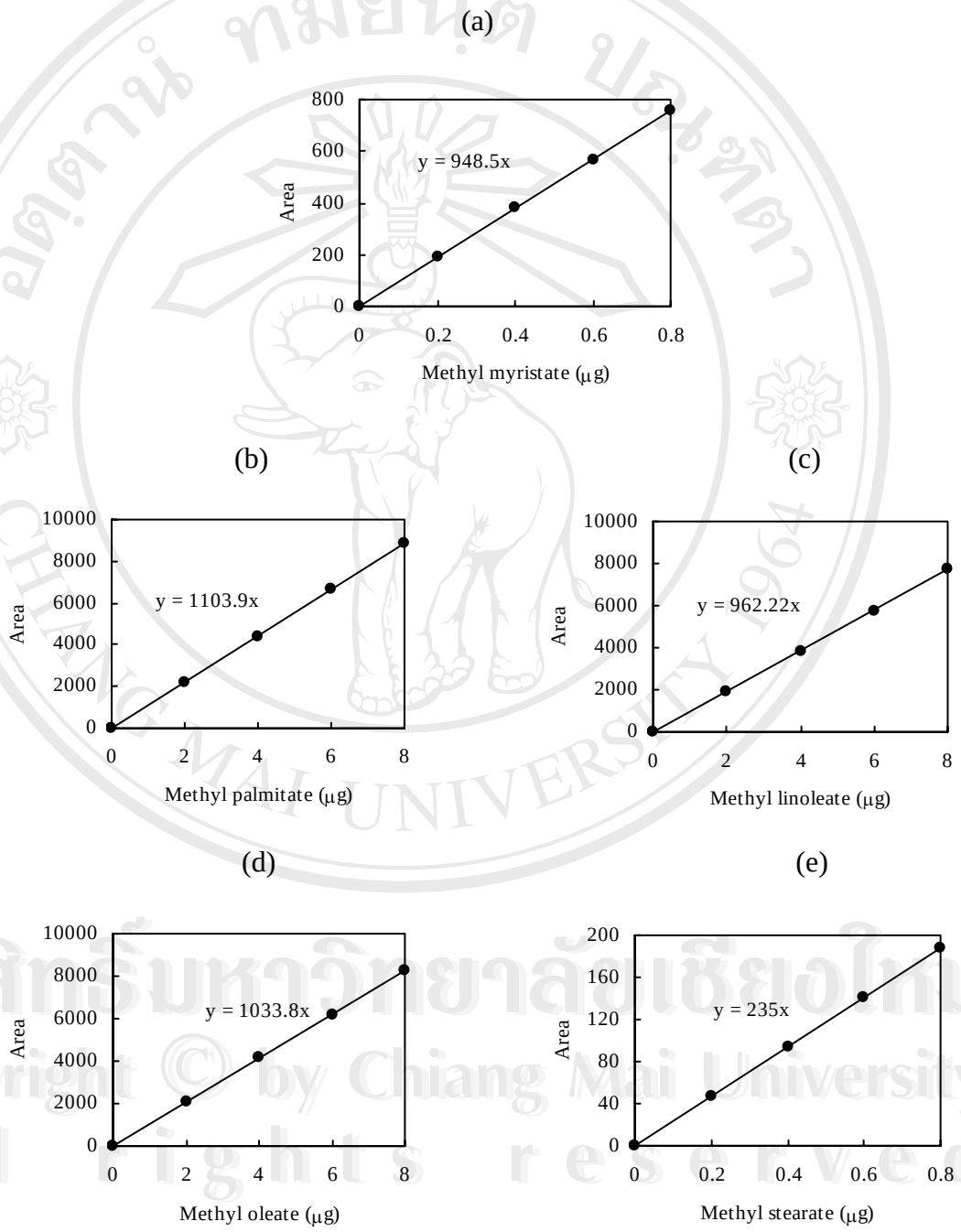


Figure D1 Standard curves of (a) methyl myristate, (b) methyl palmitate, (c) methyl linoleate, (d) methyl oleate and (e) methyl stearate.

Appendix E

GLC chromatograms of reaction mixture from alcoholysis of trimyristin

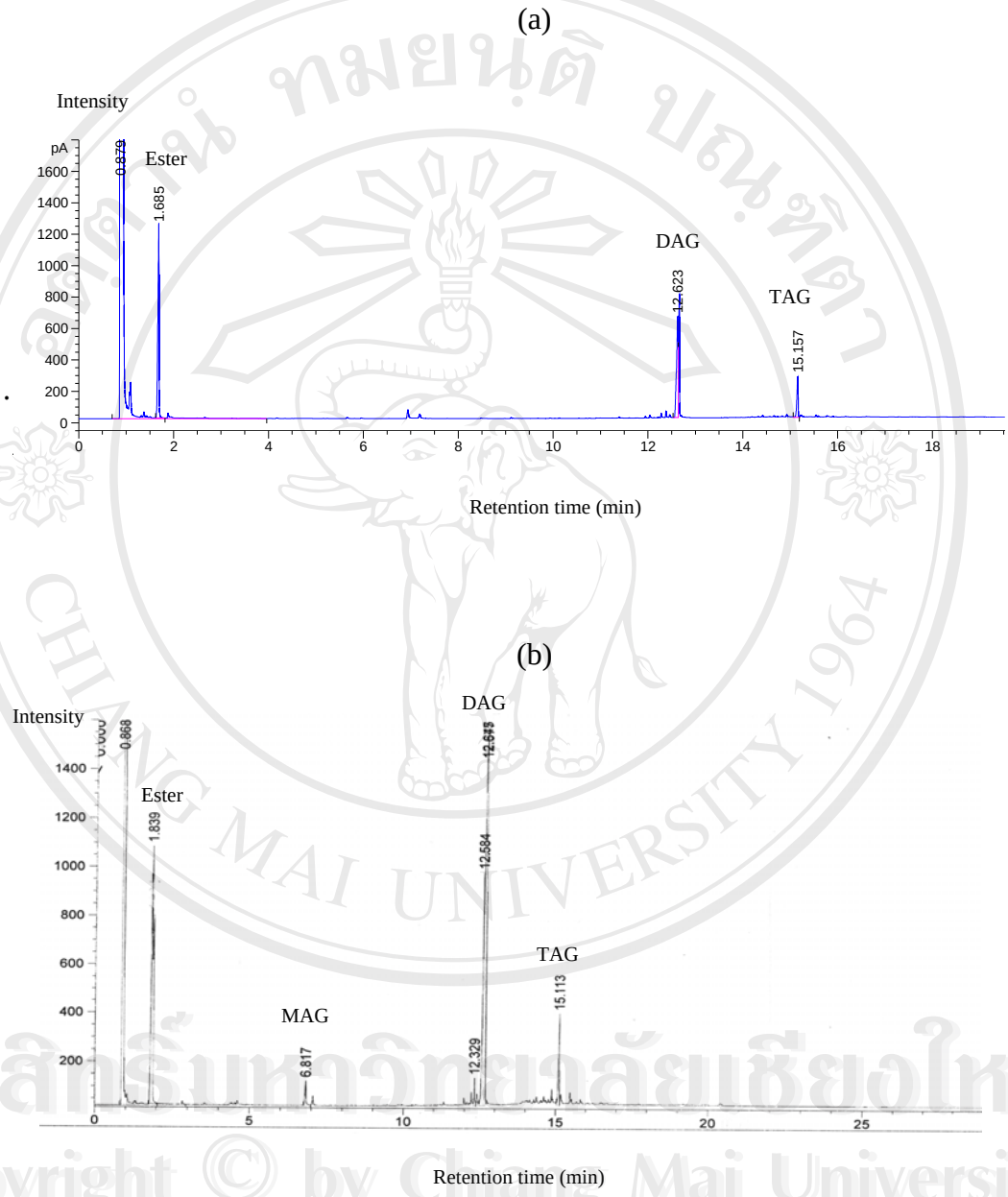
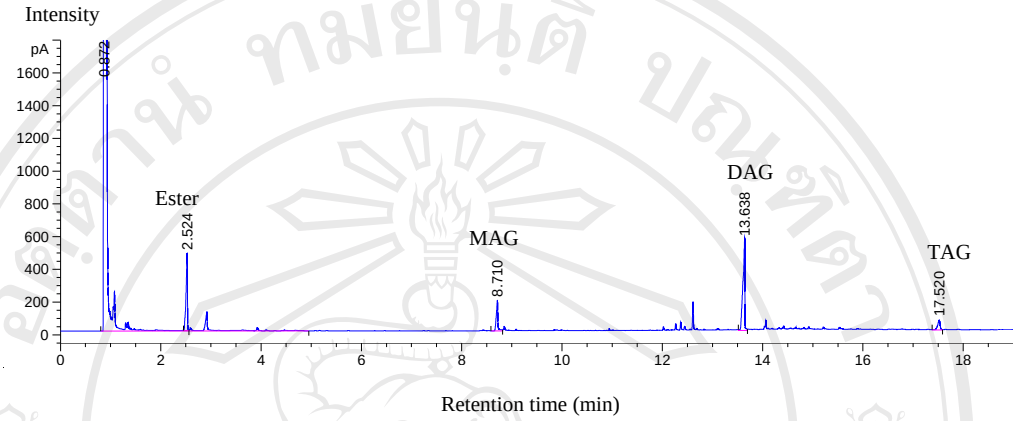


Figure E1 Chromatograms of (a) methanolysis and (b) ethanolysis of trimyristin.

Appendix F

GLC chromatograms of reaction mixture from alcoholysis of tripalmitin

(a)



(b)

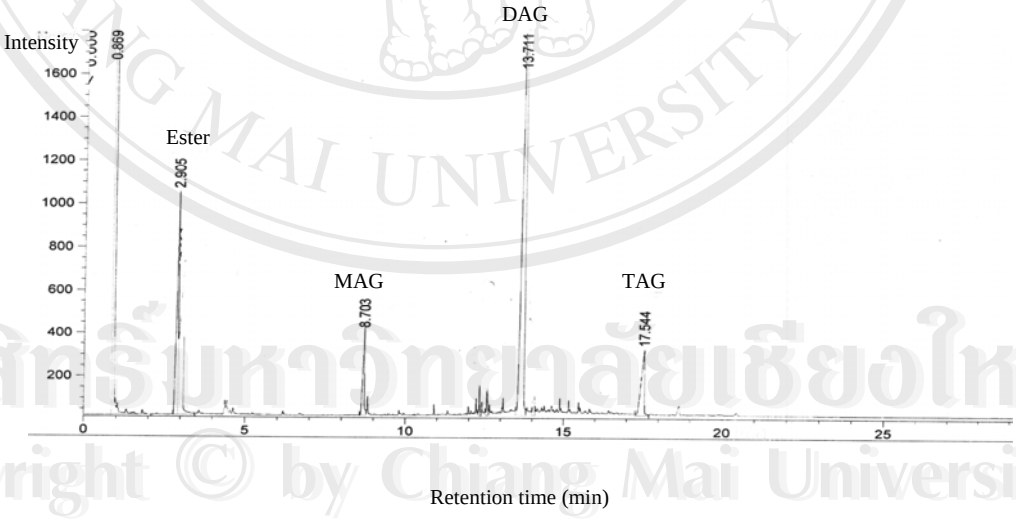


Figure F1 Chromatograms of (a) methanolysis and (b) ethanolysis of tripalmitin.

Appendix G

GLC chromatograms of reaction mixture from alcoholysis of tristearin

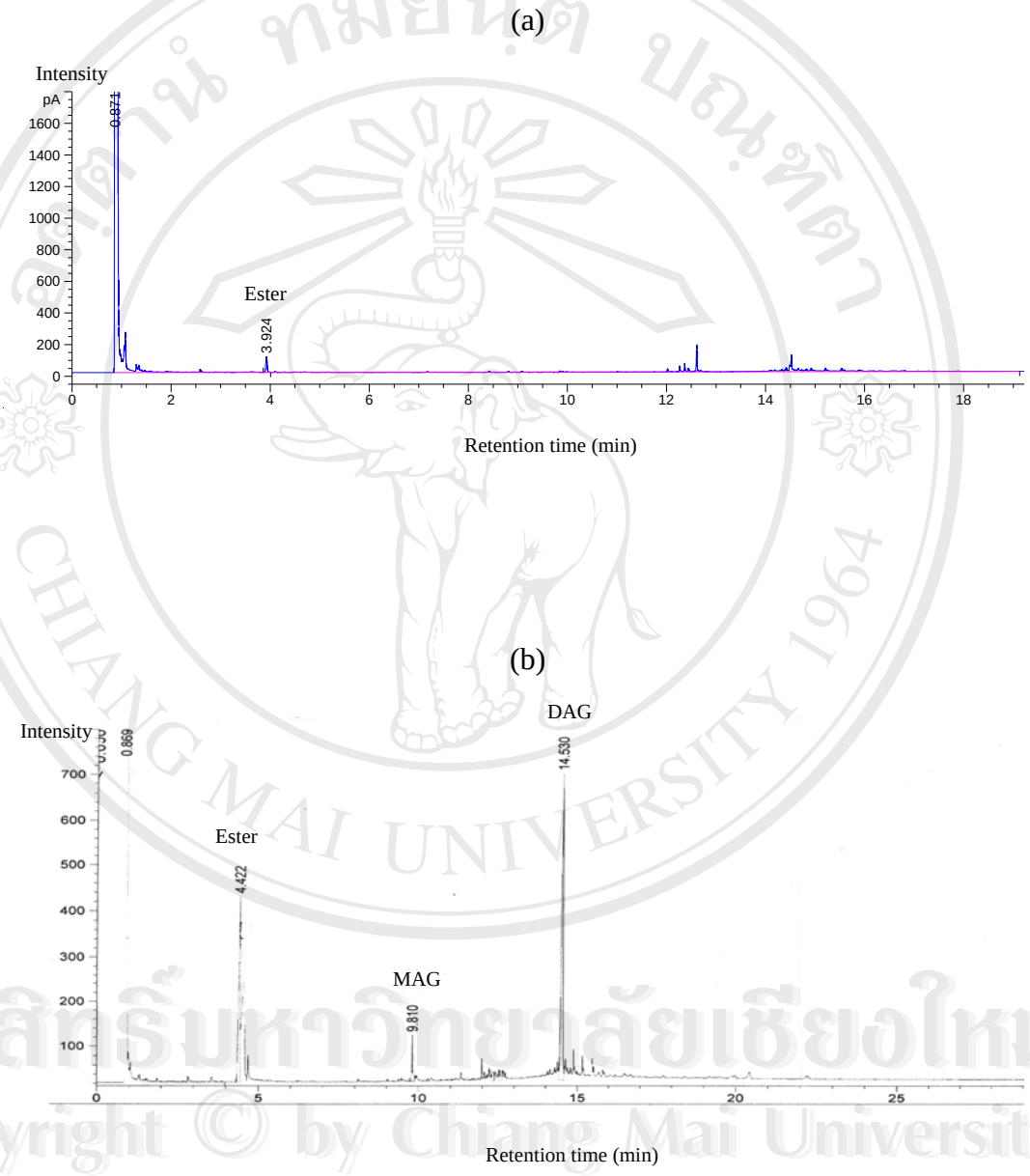


Figure G1 Chromatograms of (a) methanolysis and (b) ethanolysis of tristearin.

Appendix H

GLC chromatograms of reaction mixture from alcoholysis of triolein

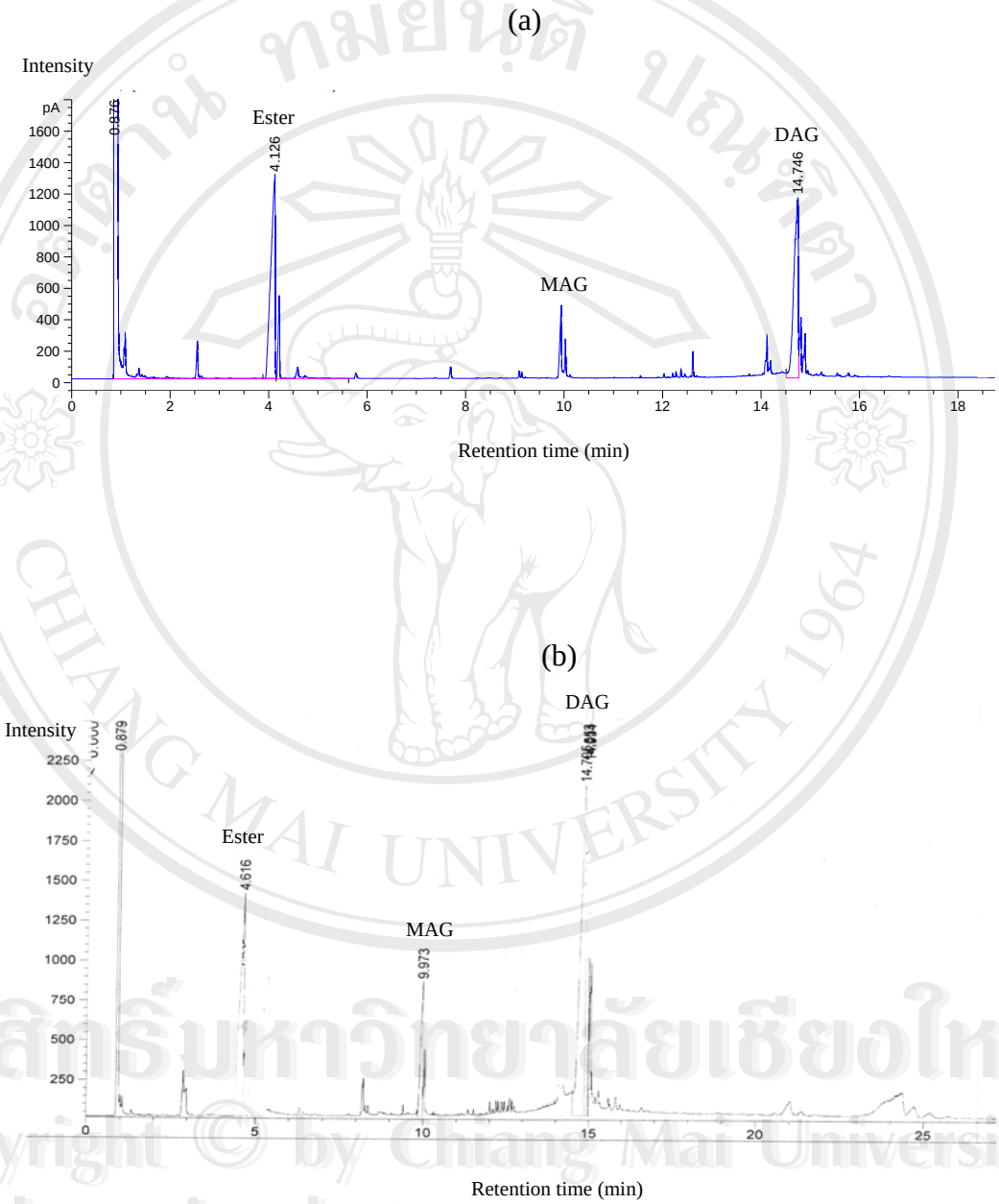


Figure H1 Chromatograms of (a) methanolysis and (b) ethanolysis of triolein.

Appendix I

Standard mass spectrum of methyl esters from analysis of palm oil composition

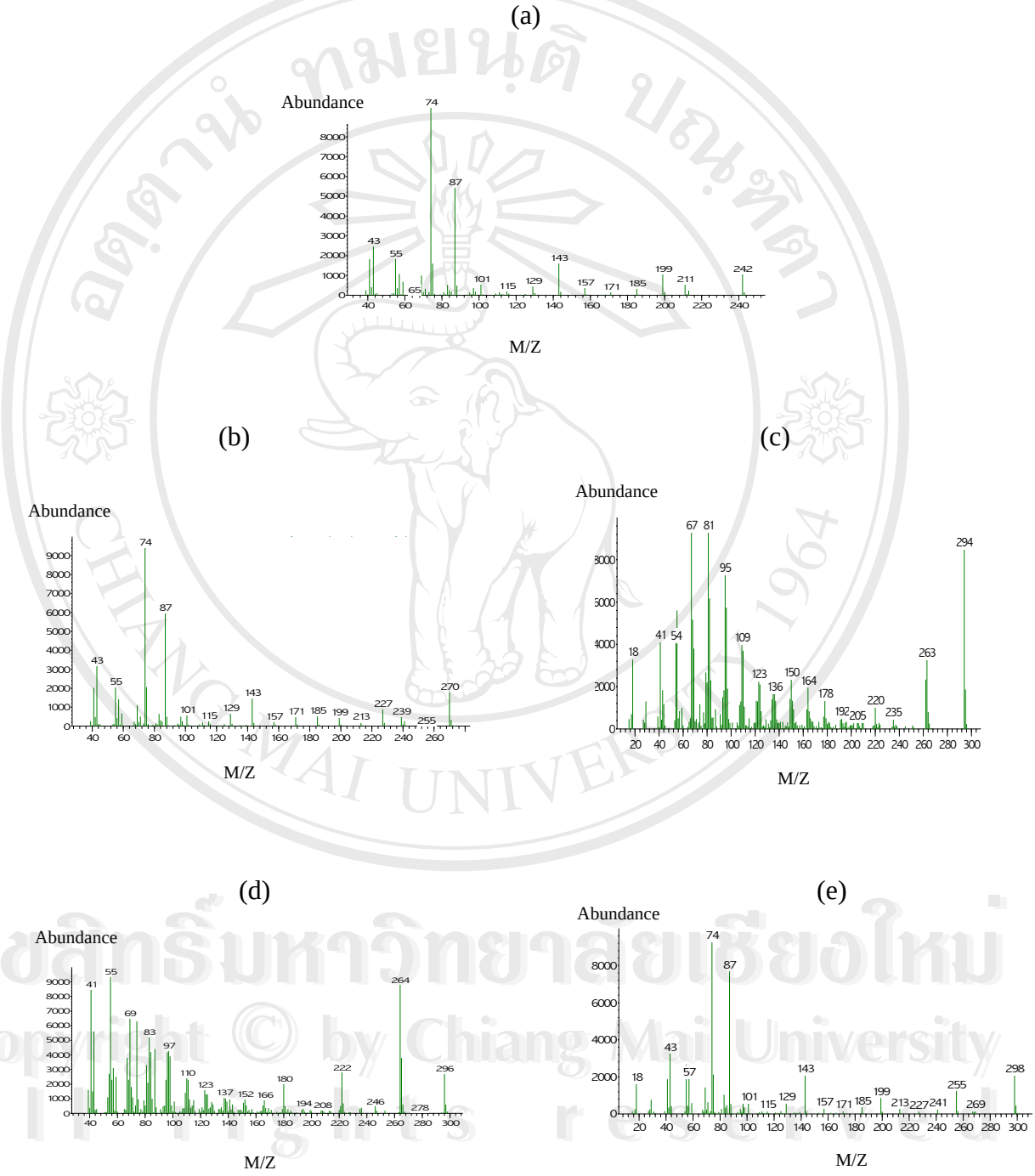


Figure I1 MS spectrum of (a) methyl myristate, (b) methyl palmitate, (c) methyl linoleate, (d) methyl oleate and (e) methyl stearate.

Appendix J

Standard curves of ethyl esters and butyl esters for determination of product contents

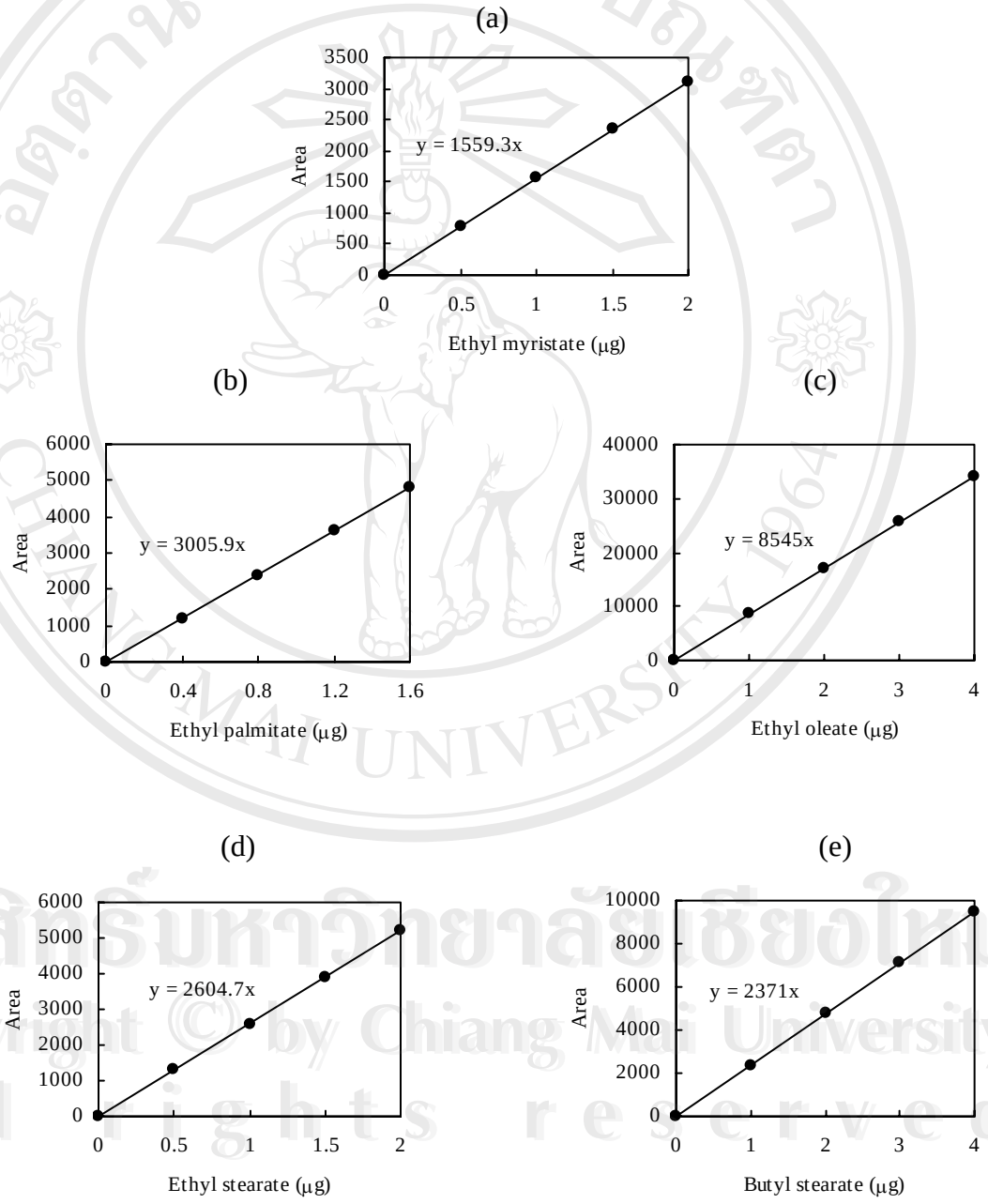
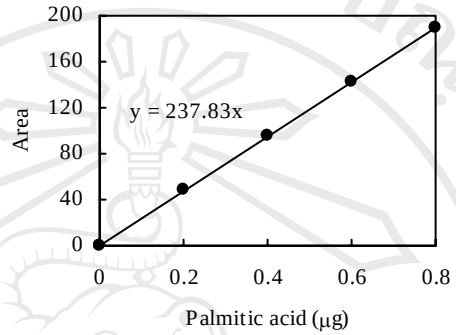


Figure J1 Standard curves of (a) ethyl myristate, (b) ethyl palmitate, (c) ethyl oleate, (d) ethyl stearate and (e) butyl stearate.

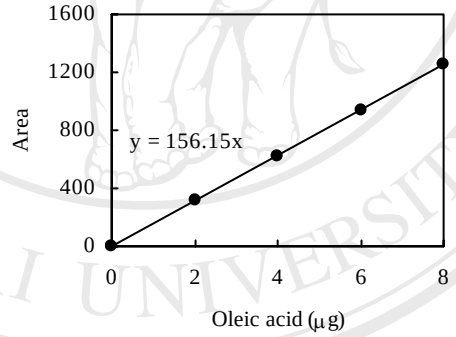
Appendix K

Standard curves of fatty acids for determination of product contents

(a)



(b)



(c)

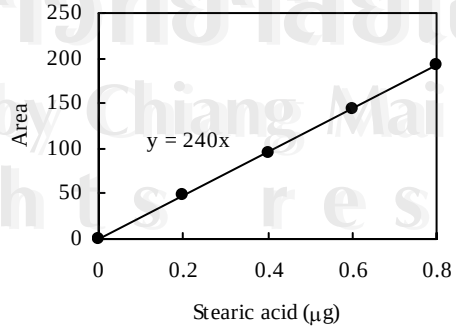


Figure K1 Standard curves of (a) palmitic acid, (b) oleic acid and (c) stearic acid.

Appendix L

Standard curves of diacylglycerols for determination of product contents

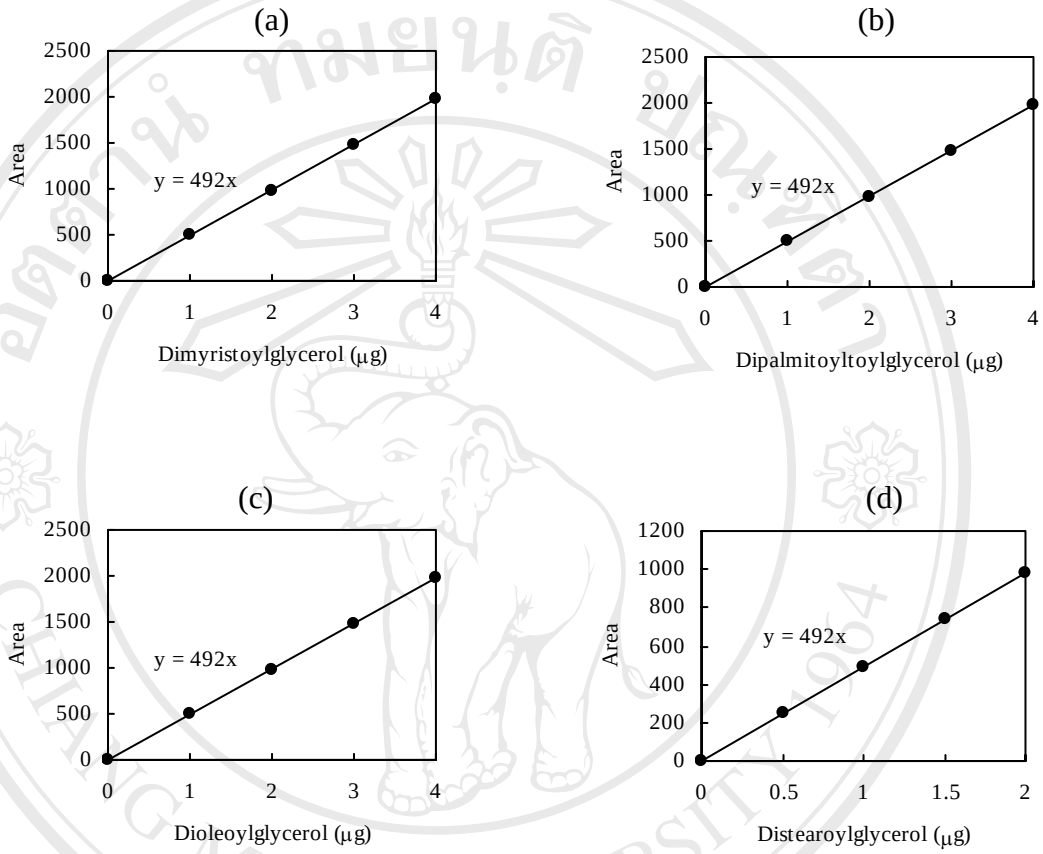


Figure L1 Standard curves of (a) dimyristoylglycerol, (b) dipalmitoylglycerol, (c) dioleoylglycerol and (d) distearoylglycerol.

Appendix M

Standard curves of monoacylglycerol for determination of product contents

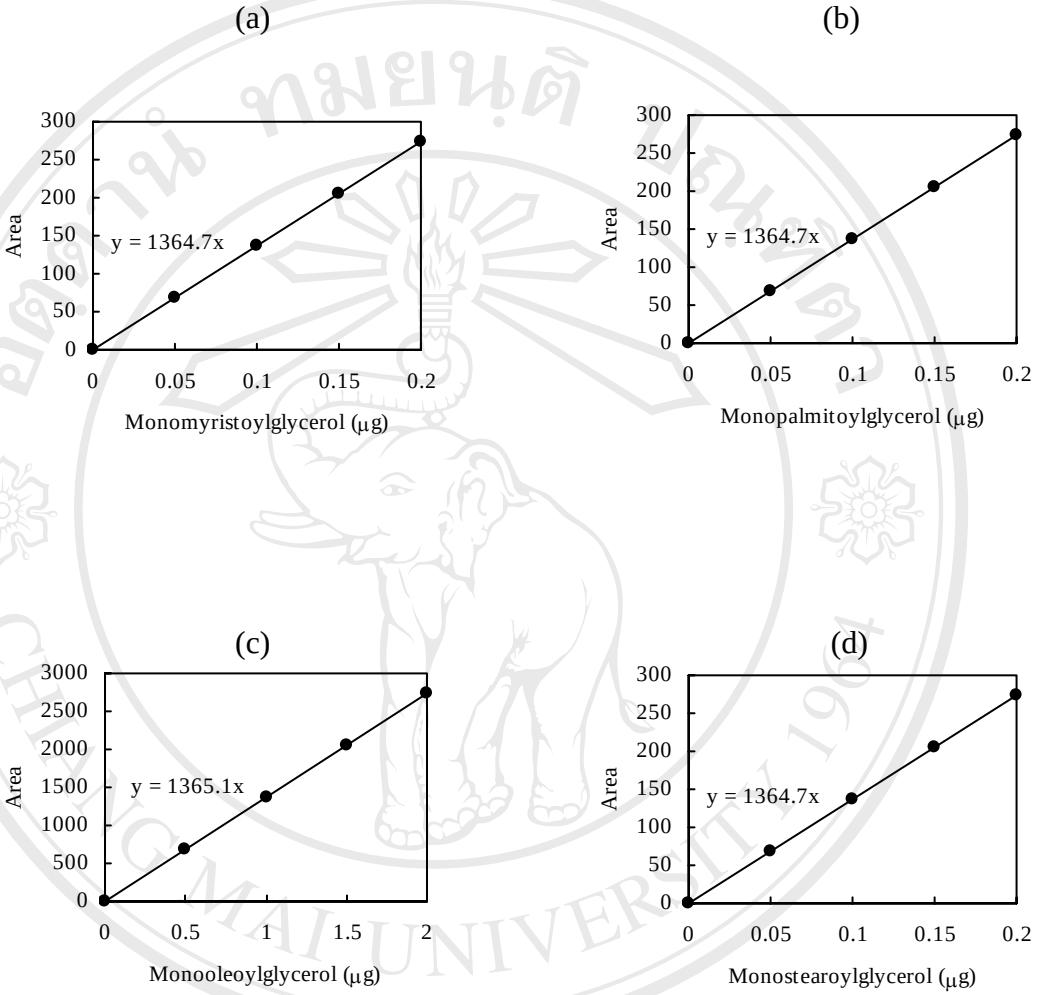


Figure M1 Standard curves of (a) monomyristoylglycerol, (b) monopalmitoyl-glycerol, (c) monooleoylglycerol and (d) monostearoylglycerol.

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Oral Presentations

1. Angkanurukpun, P. and Kanasawud, P. (2004) Formation of methyl oleate from triolein catalyzed by *Carica papaya* latex lip ase. *The 9th Biological Science Graduate Congress*, December 16-18, Chulalongkorn University, Bangkok, Thailand, p. 44.
2. Angkanurukpun, P. and Kanasawud, P. (2005) Biodiesel fuel production by *Carica papaya* lipase catalyzed-methanolysis of palm oil. *BioThailand*, November 2-5, Queen Sirikit National Convention Center, Bangkok, Thailand, p. 69.

Poster Presentations

1. Angkanurukpun, P. and Kanasawud, P. (2002) Studies on specificity of *Carica papaya* latex lipase on alcoholysis of triacylglycerols. *The 28th Congress on Science and Technology of Thailand*, October 24-26, Queen Sirikit National Convention Center, Bangkok, Thailand, p. 526.
2. Angkanurukpun, P. and Kanasawud, P. (2002) Alcoholysis of triacylglycerols by *Carica papaya* lipase. *The 14th Annual Meeting of the Thai Society for Biotechnology* "*Biotechnology for Better Living in the New Economy*", November 12-15, Sofitel Raja Orchid Hotel, Khon Kaen, Thailand, p. 161.

Publications

1. Angkanurukpun, P. and Kanasawud, P. (2005) Biodiesel fuel production by *Carica papaya* lipase catalyzed-methanolysis of palm oil. *Proceeding The International Conference on TSB Annual Meeting: Innovative Biotechnology; The Era of Bionanotechnology*. pp. 21-30.
2. Angkanurukpun, P., Sriburi, P. and Kanasawud, P. (2006) Improvement of *Carica papaya* lipase for methanolysis of triolein. *Chiang Mai J. Sci.* 33 (2): 3-8.

Scholarships

2001-2003	Uttaradit Rajabhat University
2003	National Research Council of Thailand
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