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APPENDIX

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APPENDIX A

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย



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Figure 1A FT-IR spectrum of the wax fraction eluted at 20 °C.

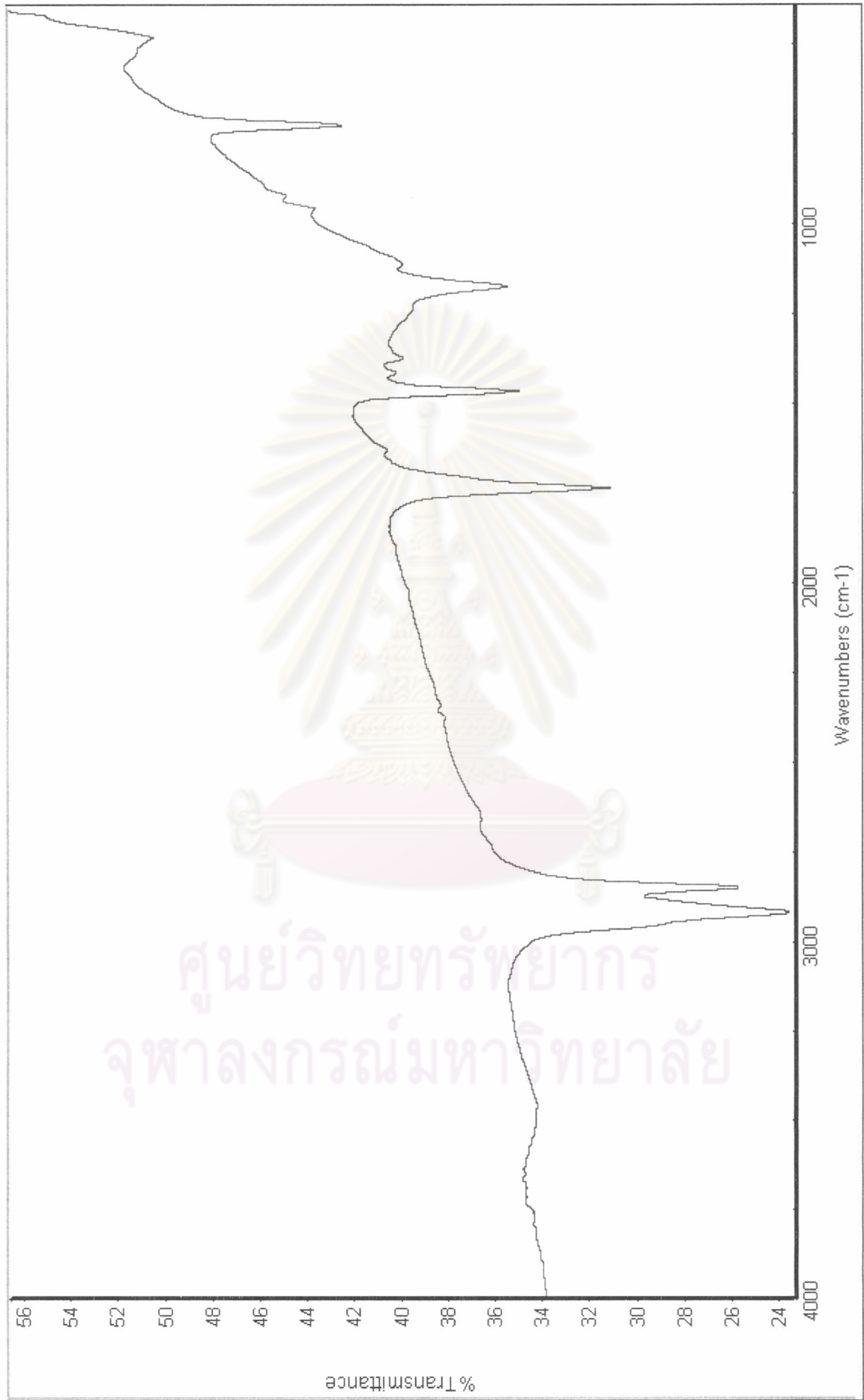


Figure 2A FT-IR spectrum of the wax fraction eluted at 30 °C.



Figure 3A FT-IR spectrum of the wax fraction eluted at 40 °C.

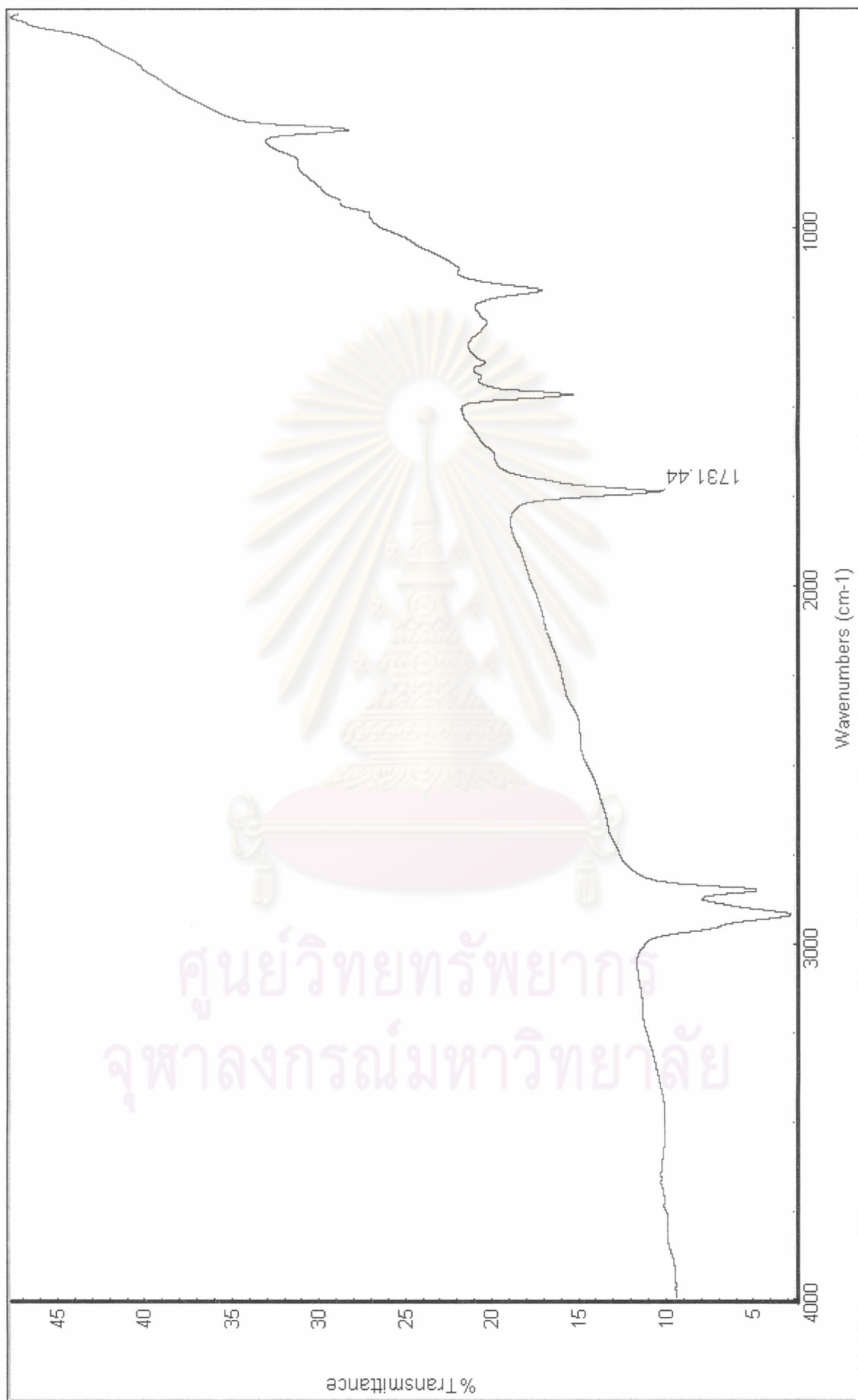


Figure 4A FT-IR spectrum of the wax fraction eluted at 50 °C.



Figure 5A FT-IR spectrum of the raw rice bran wax.



APPENDIX B

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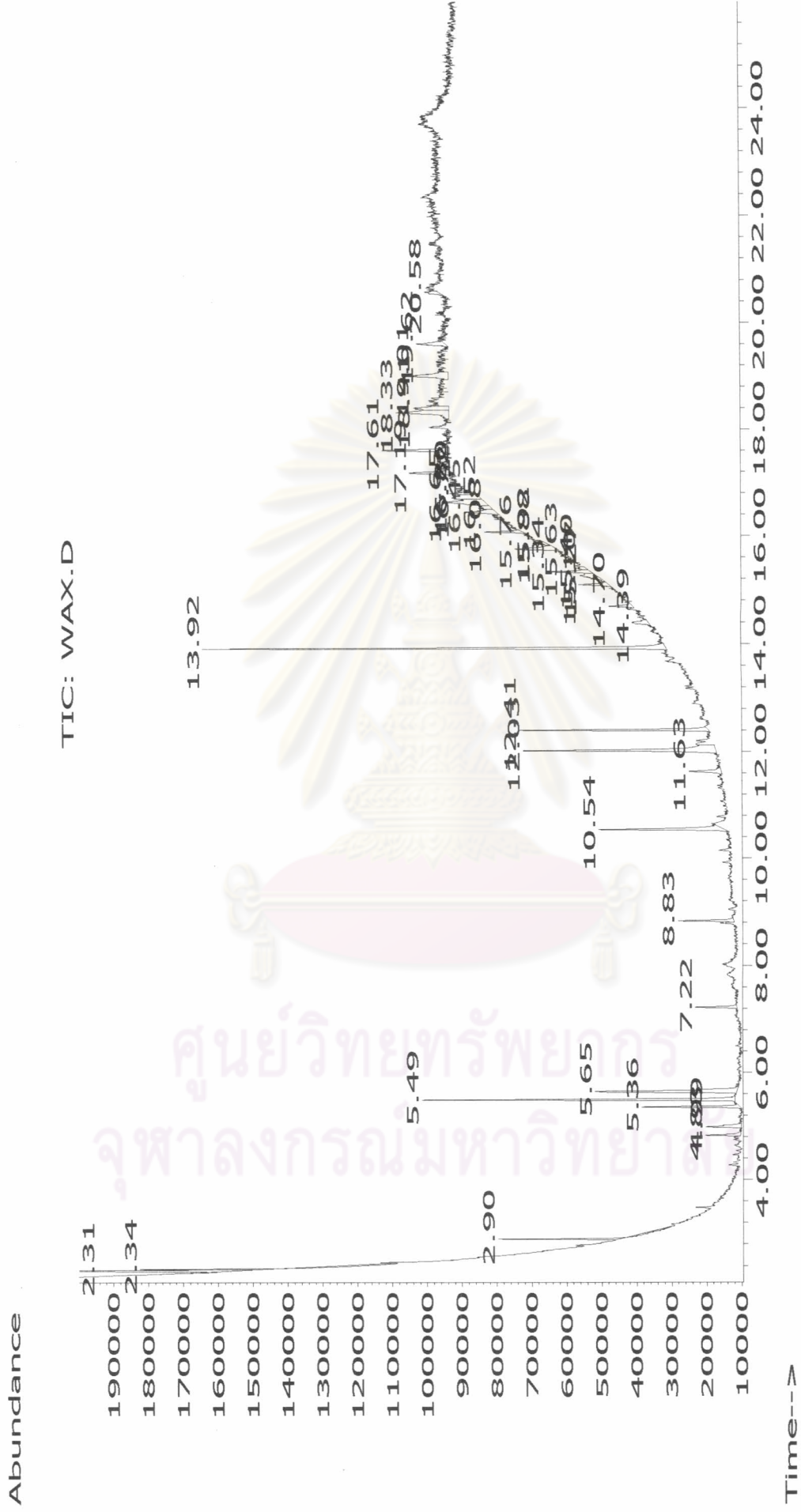


Figure 1B GC-MS Spectrum of rice bran wax

Wax fraction profiles

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Quality
1	2.31	5.40	C:\Database\wiley7n.l			
			Benzene, 1,3-dimethyl-	10740	000108-38-3	94
			Benzene, 1,3-dimethyl-	10745	000108-38-3	81
			XYLENE	10747	001330-20-7	81
2	2.34	0.40	C:\Database\wiley7n.l			
			Benzene, 1,3-dimethyl-	10740	000108-38-3	94
			XYLENE	10747	001330-20-7	94
			p-Xylene	10751	000106-42-3	93
3	2.90	1.48	C:\Database\wiley7n.l			
			Decanoic acid, ethyl ester	115400	000110-38-3	97
			Decanoic acid, ethyl ester	115404	000110-38-3	95
			Decanoic acid, ethyl ester	115399	000110-38-3	90
9	7.22	1.15	C:\Database\wiley7n.l			
			Hexadecanoic acid, methyl ester	213911	000112-39-0	95
			Pentadecanoic acid, methyl ester	213933	005129-60-2	90
			Hexadecanoic acid, methyl ester	213890	000112-39-0	89
10	8.83	1.49	C:\Database\wiley7n.l			
			9-Octadecenoic acid (Z)-, methy...	245471	000112-62-9	46
			9-Octadecenoic acid (Z)-, methy...	245467	000112-62-9	46
			10-Octadecenoic acid, methyl ester	245511	013481-95-3	42
14	12.41	5.53	C:\Database\wiley7n.l			
			Docosanoic acid, methyl ester	302040	000929-77-1	99
			Docosanoic acid, methyl ester	302033	000929-77-1	99
			Docosanoic acid, methyl ester	302032	000929-77-1	99
15	13.92	13.49	C:\Database\wiley7n.l			
			Tetracosanoic acid, methyl ester	321683	002442-49-1	99
			Tetracosanoic acid, methyl ester	321682	002442-49-1	99
			Tetracosanoic acid, methyl ester	321680	002442-49-1	99

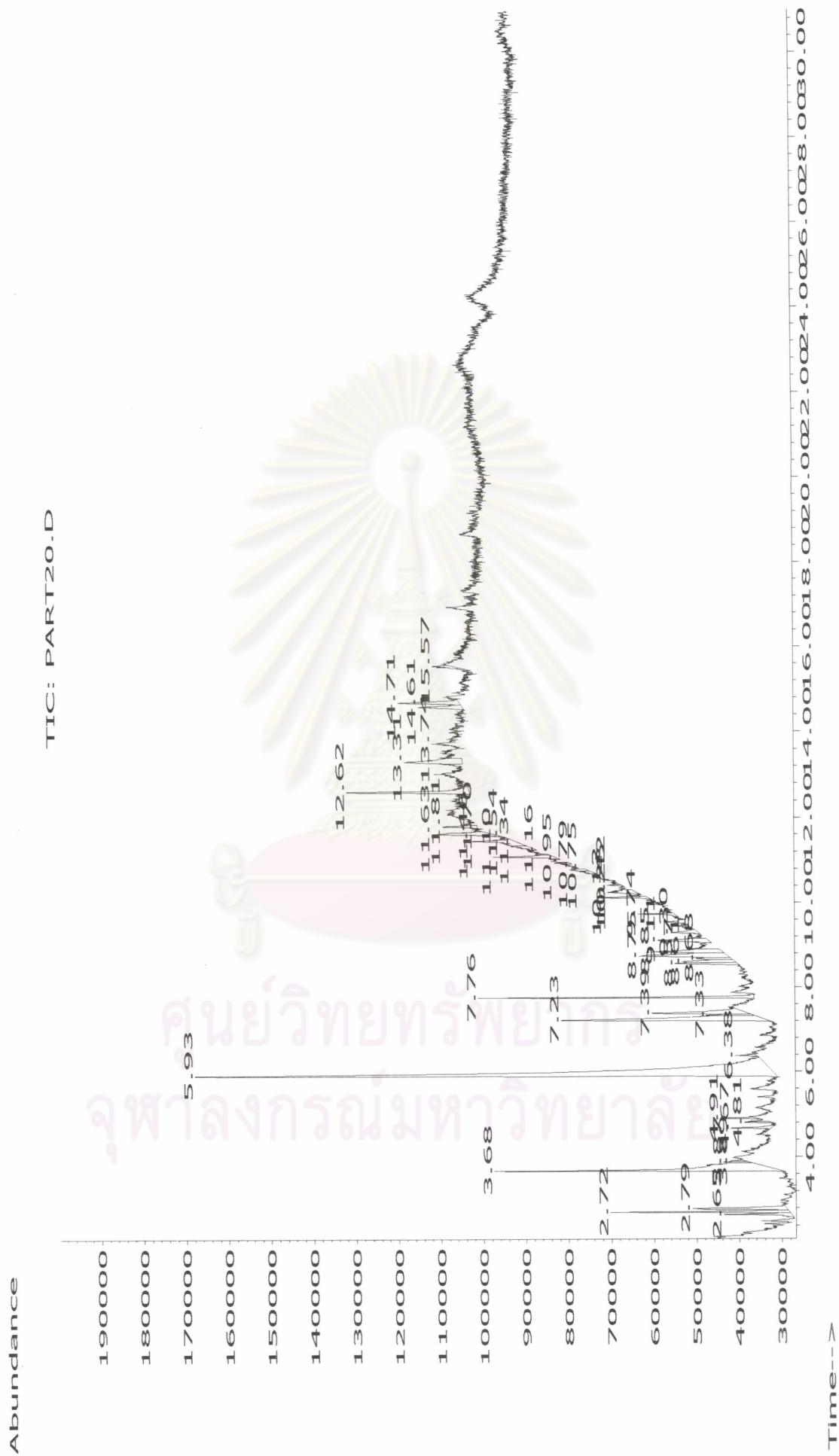


Figure 2B GC-MS Spectrum of the wax fraction eluted at 20 °C.

Wax fraction at 20 °C Profiles

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Quality
1	2.65	1.21	C:\Database\wiley7n.1			
			Benzene, 1,1'-(1,2-ethanediyl)b...	131090	000538-39-6	64
			Benzene, 1,1'-(1,2-ethanediyl)b...	131091	000538-39-6	64
			Benzene, 1,1'-(1,2-ethanediyl)b...	131092	000538-39-6	64
2	2.72	3.03	C:\Database\wiley7n.1			
			Benzene, 1,1'-(1,2-ethanediyl)b...	131092	000538-39-6	90
			Benzene, 1,1'-(1,2-ethanediyl)b...	131090	000538-39-6	87
			Benzene, 1,1'-(1,2-ethanediyl)b...	131089	000952-80-7	87
3	2.79	2.34	C:\Database\wiley7n.1			
			Benzene, 1,1'-(1,2-ethanediyl)b...	131092	000538-39-6	87
			Benzene, 1,1'-(1,2-ethanediyl)b...	131089	000952-80-7	87
			Benzene, 1,1'-(1,2-ethanediyl)b...	131090	000538-39-6	86
4	3.68	9.62	C:\Database\wiley7n.1			
			Hexadecanoic acid (CAS) \$\$ Palm...	195440	000057-10-3	99
			Hexadecanoic acid (CAS) \$\$ Palm...	195439	000057-10-3	99
			n-Hexadecanoic acid	195430	000057-10-3	99
14	7.39	3.15	C:\Database\wiley7n.1			
			Octadecanedioic acid \$\$ Hexadec...	265118	000871-70-5	27
			tetradecanedioic acid dimethyl ...	233358	005024-21-5	27
			1-Propanone, 1-phenyl-3-(1-pipe...	140058	000000-00-0	14
20	8.85	2.30	C:\Database\wiley7n.1			
			Hexadecanedioic acid, dimethyl ...	265122	019102-90-0	27
			Hexanedioic acid, dioctyl ester...	313827	000123-79-5	14
			Cyclononane	36154	003350-30-9	14
24	10.13	0.74	C:\Database\wiley7n.1			
			Eicosane (CAS) \$\$ n-Eicosane	228989	000112-95-8	86
			Eicosane (CAS) \$\$ n-Eicosane	228990	000112-95-8	86
			Eicosane (CAS) \$\$ n-Eicosane	228986	000112-95-8	70

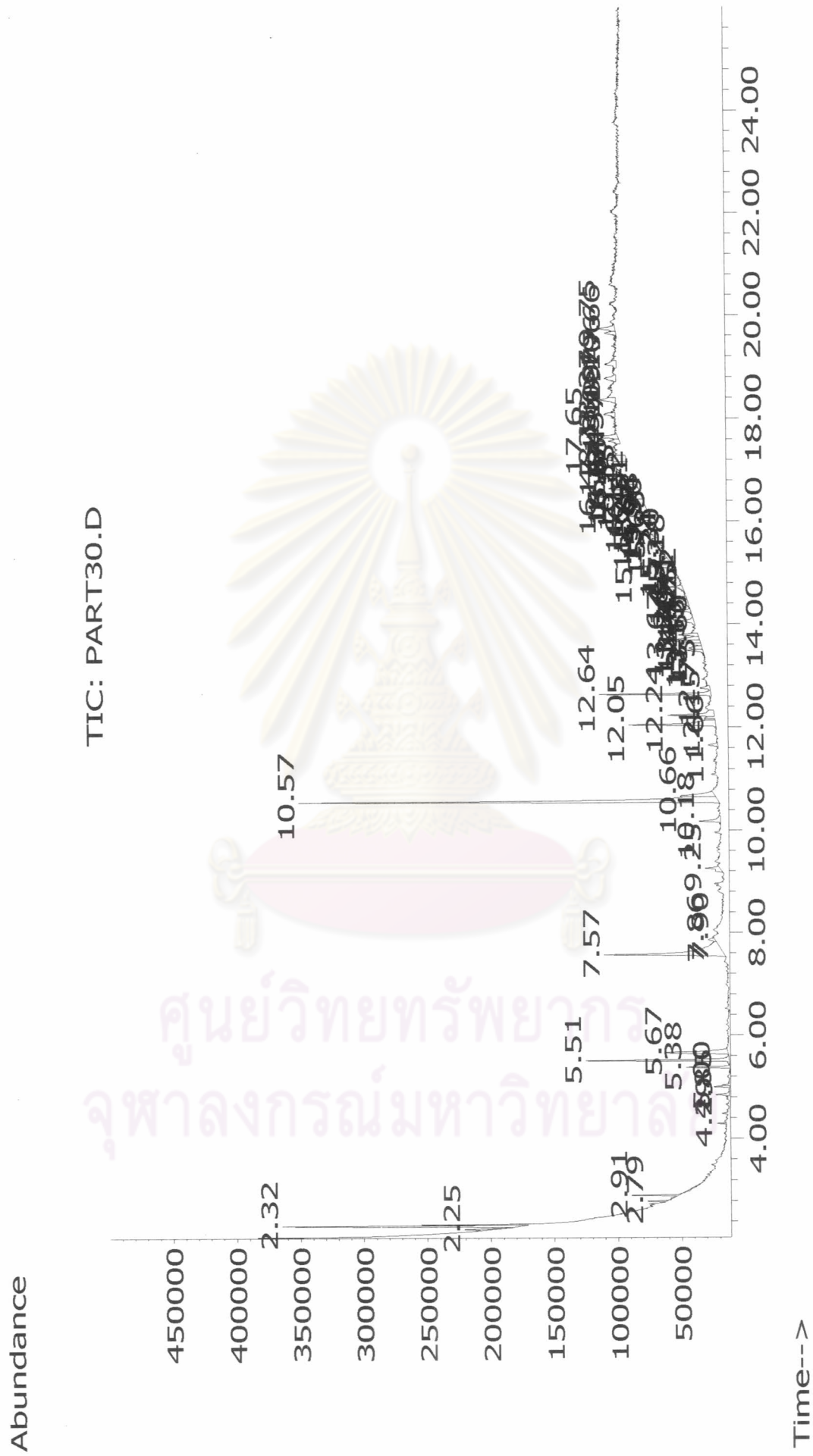


Figure 3B GC-MS Spectrum of the wax fraction eluted at 30 °C.

Wax fraction at 30 °C Profiles

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Quality
1	2.25	0.83	C:\Database\wiley7n.l			
			Nonanoic acid	57726	000112-05-0	91
			Nonanoic acid (CAS) \$\$ Nonoic a...	57723	000112-05-0	90
			Nonanoic acid (CAS) \$\$ Nonoic a...	57725	000112-05-0	86
4	2.91	0.68	C:\Database\wiley7n.l			
			Decanoic acid, ethyl ester \$\$ C...	115397	000110-38-3	95
			Decanoic acid, ethyl ester (CAS...	115400	000110-38-3	94
			Decanoic acid, ethyl ester (CAS...	115402	000110-38-3	83
5	4.29	0.20	C:\Database\wiley7n.l			
			Dodecanoic acid, ethyl ester (C...	157263	000106-33-2	80
			Tetradecanoic acid, ethyl ester...	195474	000124-06-1	80
			Dodecanoic acid, ethyl ester (C...	157256	000106-33-2	78
11	7.57	9.38	C:\Database\wiley7n.l			
			Hexadecanoic acid (CAS) \$\$ Palm...	195439	000057-10-3	99
			Hexadecanoic acid (CAS) \$\$ Palm...	195440	000057-10-3	99
			n-Hexadecanoic acid	195432	000057-10-3	99
32	14.41	0.72	C:\Database\wiley7n.l			
			Nonadecane	211479	000629-92-5	38
			Nonadecane	211482	000629-92-5	38
			2-Methyl-Z-4-tetradecene	131077	000000-00-0	35
35	15.13	1.51	C:\Database\wiley7n.l			
			Eicosane (CAS) \$\$ n-Eicosane	228990	000112-95-8	97
			Eicosane (CAS) \$\$ n-Eicosane	228982	000112-95-8	95
			Eicosane	228987	000112-95-8	95
40	15.78	1.63	C:\Database\wiley7n.l			
			Hexadecane, 1-(ethenyloxy)- \$\$...	211413	000822-28-6	81
			1-Hexadecanol, 3,7,11,15-tetram...	248014	000645-72-7	64
			1-Octadecene	190567	000112-88-9	64
44	16.11	1.41	C:\Database\wiley7n.l			
			16-Octadecenal	208782	056554-87-1	86
			14-Octadecenal	208780	056554-89-3	62
			Cyclopentadecanol-	154795	004727-17-7	58

47	16.49	2.24	C:\Database\wiley7n.l		
			Octadecane \$\$ n-Octadecane \$\$ O...	193177	000593-45-3 96
			Eicosane (CAS) \$\$ n-Eicosane	228990	000112-95-8 93
			Eicosane (CAS) \$\$ n-Eicosane	228986	000112-95-8 93
55	18.08	0.70	C:\Database\wiley7n.l		
			Nonadecane	211478	000629-92-5 64
			Nonadecane	211482	000629-92-5 64
			Nonadecane	211479	000629-92-5 64



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Abundance

TIC: PART40.D

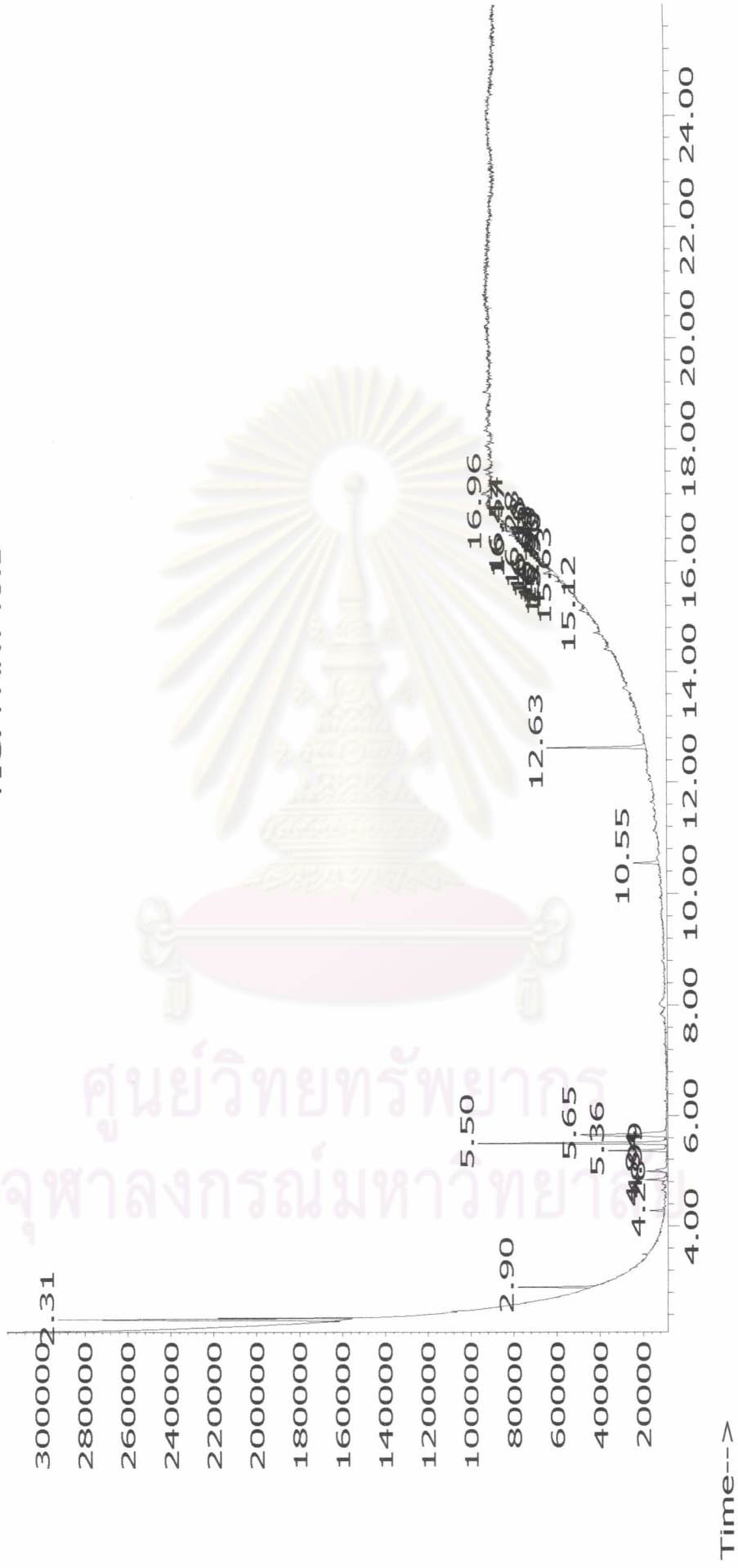


Figure 4B GC-MS Spectrum of the wax fraction eluted at 40 °C.

Wax fraction at 40 °C Profiles

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Quality
1	2.31	24.10	C:\Database\wiley7n.l			
			Benzene, 1,2-dimethyl-	10727	000095-47-6	53
			p-Xylene	10758	000106-42-3	46
			Benzene, 1,3-dimethyl-	10744	000108-38-3	45
2	2.90	4.98	C:\Database\wiley7n.l			
			Decanoic acid, ethyl ester (CAS...	115400	000110-38-3	97
			Decanoic acid, ethyl ester (CAS...	115404	000110-38-3	87
			Decanoic acid, ethyl ester	115399	000110-38-3	87
3	4.28	1.12	C:\Database\wiley7n.l			
			Dodecanoic acid, ethyl ester	157260	000106-33-2	38
			Hexadecanoic acid, ethyl ester ...	231395	000628-97-7	25
			Dodecanoic acid, ethyl ester (C...	157256	000106-33-2	25

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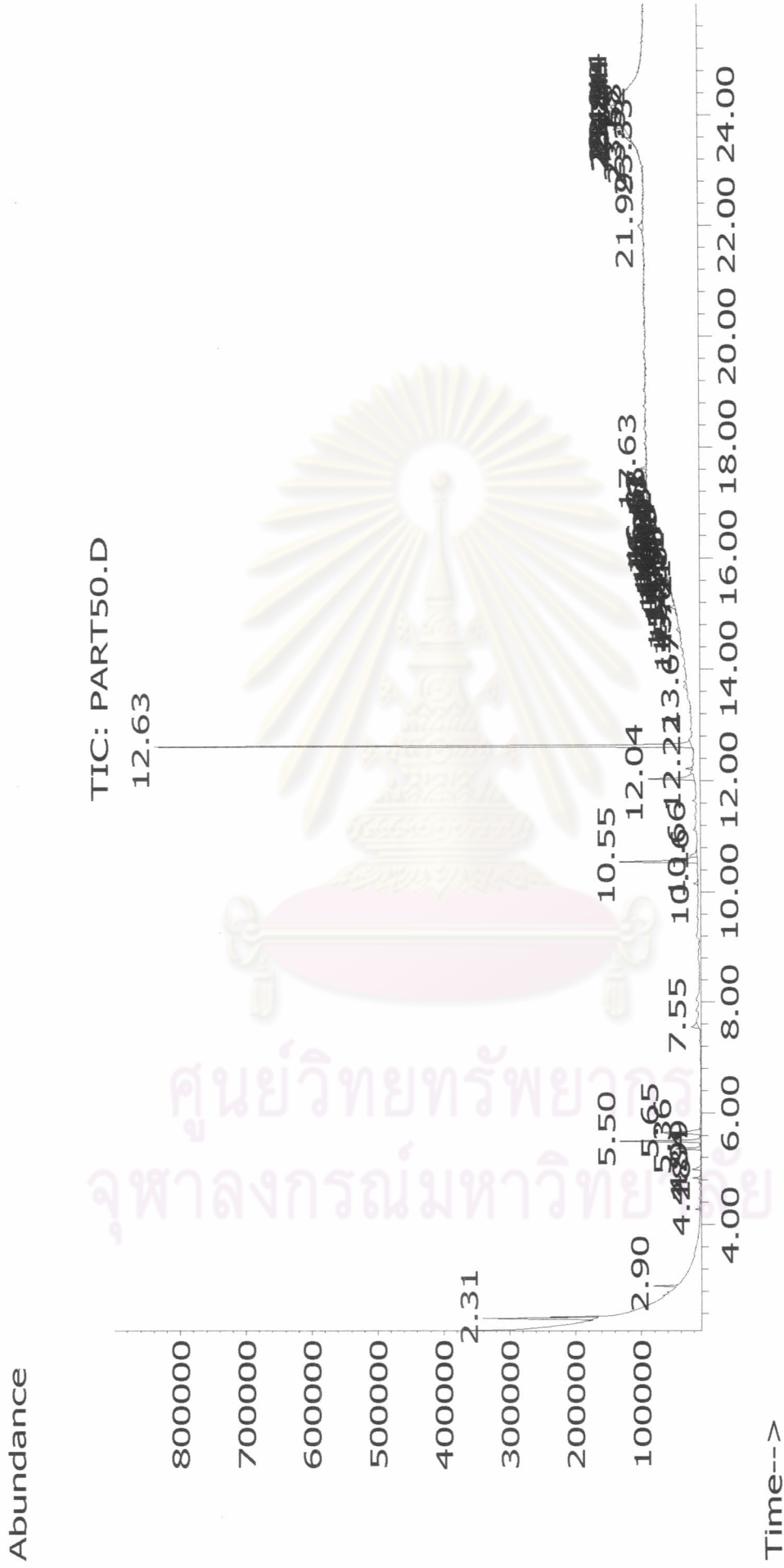


Figure 5B GC-MS Spectrum of the wax fraction eluted at 50 °C.

Wax fraction at 50 °C Profiles

Pk#	RT	Area%	Library/ID	Ref#	CAS#	Quality
2	2.90	1.26	C:\Database\wiley7n.l			
			Decanoic acid, ethyl ester (CAS...	115400	000110-38-3	99
			Decanoic acid, ethyl ester	115399	000110-38-3	95
			Decanoic acid, ethyl ester \$\$ C...	115397	000110-38-3	95
3	4.28	0.30	C:\Database\wiley7n.l			
			Dodecanoic acid, ethyl ester (C...	157256	000106-33-2	86
			Dodecanoic acid, ethyl ester (C...	157258	000106-33-2	80
			Tetradecanoic acid, ethyl ester...	195475	000124-06-1	80
9	7.55	1.00	C:\Database\wiley7n.l			
			Hexadecanoic acid (CAS) \$\$ Palm...	195439	000057-10-3	97
			Hexadecanoic acid (CAS) \$\$ Palm...	195443	000057-10-3	97
			Hexadecanoic acid (CAS) \$\$ Palm...	195442	000057-10-3	93
14	12.22	0.50	C:\Database\wiley7n.l			
			Octadecanedioic acid \$\$ Hexadec...	265118	000871-70-5	35
			Hexadecanedioic acid, dimethyl ...	265122	019102-90-0	32
			Dodecanoic acid (CAS) \$\$ Lauric...	115386	000143-07-7	27
19	15.12	0.62	C:\Database\wiley7n.l			
			Eicosane (CAS) \$\$ n-Eicosane	228990	000112-95-8	60
			Eicosane (CAS) \$\$ n-Eicosane	228993	000112-95-8	55
			Eicosane	228987	000112-95-8	55

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APPENDIX C

ศูนย์วิทยทรัพยากร
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Fractions	Volume of 0.5 N HCl Blank	Volume of 0.5 N HCl sample	Volume of 0.5 N HCl sample	Sample wax 1 (gram)	Sample wax 2 (gram)	K	Saponification value (1)	Average saponification value (1)	Saponification value (2)	Average saponification value (2)
20 °C	9.70	9.25	9.30	0.0518	0.0495	28.543	247.96		230.65	
20 °C	9.70	9.25	9.28	0.0495	0.0488	28.543	257.72	252.84	240.16	235.40
30 °C	9.70	9.30	9.25	0.0723	0.0788	28.543	157.91		162.99	
30 °C	9.70	9.31	9.30	0.0687	0.7400	28.543	162.34	160.12	164.24	163.62
40 °C	9.70	9.30	9.30	0.0809	0.0795	28.543	141.12		143.61	
40 °C	9.70	9.34	9.34	0.0710	0.0568	28.543	144.65	142.89	145.79	144.70
50 °C	9.70	9.35	9.45	0.0790	0.0535	28.543	126.45		133.37	
50 °C	9.70	9.34	9.33	0.0777	0.0480	28.543	133.34	129.90	136.91	135.14
Raw wax	9.70	3.90	5.00	1.0400	0.8050	28.543	159.18		166.64	
Raw wax	9.70	3.08	3.14	1.1000	0.0900	28.543	171.68	165.43	170.20	168.47

Table 1C Raw data for saponification value of wax

Fractions	Normality of alkali	Mililitres of alkali(1) ml	Mililitres of alkali(2) ml	Sample wax 1 (gram)	Sample wax 2 (gram)	K	Acid Value(1)	Average acid value (1)	Acid value (2)	Average acid value (2)
20 °C	0.1036	0.20	0.18	0.047	0.045	56.1	24.73		23.24	
20 °C	0.1036	0.20	0.16	0.045	0.040	56.1	25.69	25.21	23.35	23.292
30 °C	0.1036	0.18	0.20	0.074	0.081	56.1	13.74		14.35	
30 °C	0.1036	0.17	0.19	0.075	0.076	56.1	13.09	13.41	14.62	14.49
40 °C	0.1036	0.08	0.08	0.087	0.080	56.1	5.01		5.44	
40 °C	0.1036	0.08	0.07	0.089	0.075	56.1	5.10	5.06	5.57	5.51
50 °C	0.1036	0.10	0.10	0.047	0.052	56.1	12.73		11.57	
50 °C	0.1036	0.15	0.17	0.049	0.055	56.1	17.53	15.13	17.46	14.52
Raw wax	0.1036	3.40	3.40	0.951	0.880	56.1	20.77		22.45	
Raw raw	0.1036	3.41	3.59	0.955	0.900	56.1	20.78	20.78	23.16	22.81

Table 2C Raw data for Acid value of wax

Fractions	Titration of blank	Titration of sample(1)	Titration of sample(2)	Nomality of $\text{Na}_2\text{S}_2\text{O}_3$	Weight of sample (0.05g)	K	Iodine Value(1)	Average iodine value (1)	Iodine Value(2)	Average iodine value (2)
20 °C	25.0	23.0	23.1	0.1088	0.05	12.69	55.23		52.47	
20 °C	25.0	23.2	22.9	0.1088	0.05	12.69	49.13	52.18	57.01	54.74
30 °C	25.0	23.5	23.4	0.1088	0.05	12.69	41.42		44.18	
30 °C	25.0	23.3	23.3	0.1088	0.05	12.69	47.60	44.51	47.40	45.79
40 °C	25.0	24.5	24.6	0.1088	0.05	12.69	13.81		12.43	
40 °C	25.0	24.7	24.6	0.1088	0.05	12.69	8.69	11.25	11.35	11.89
50 °C	25.0	24.7	24.8	0.1088	0.05	12.69	8.28		6.90	
50 °C	25.0	24.7	24.7	0.1088	0.05	12.69	9.10	8.69	7.92	7.41
Raw wax	25.0	23.9	23.7	0.1088	0.05	12.69	30.37		35.90	
Raw wax	25.0	24.2	23.9	0.1088	0.05	12.69	22.63	26.50	30.10	33.00

Table 3C Raw data for Iodine value of wax

VITA

Chantadech Khositcharoenkul was born on March 10, 1980 in Bangkok, Thailand. He received his Bachelor's Degree of Science in Plant Science from Mahidol University in 2003. He continued his Master's Degree of Science in Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University and finished in 2006.



ศูนย์วิทยทรัพยากร
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