V. SIMPULAN DAN SARAN

A. Simpulan

Ada beberapa hal yang dapat disimpulkan dari hasil penelitian skripsi ini.

1. Minyak ginseng Jawa mengandung tiga jenis asam lemak mayor yaitu asam heksadekanoat (asam palmitat) 55,84±0,805%, asam oktadekadienoat (asam linoleat) dengan kadar 16,86±0,440% dan beberapa asam lemak dari kelompok asam n-oktadesenoat dengan kadar 19,65±0,873%.
2. Reaksi transesterifikasi yang digunakan pada penelitian ini ternyata belum berhasil mengubah minyak ginseng Jawa menjadi biodisel (menggunakan 9,8 gram minyak ginseng Jawa dengan katalis NaOH 0,3%, metanol 2 gram, suhu di atas 68^{o}C, lama reaksi 1 jam) sehingga nilai tingkat konversi minyak ginseng Jawa menjadi biodiesel belum diperoleh pada penelitian ini dan tujuan kedua penelitian ini belum tercapai.

B. Saran

Pada penelitian ini, tingkat konversi minyak ginseng Jawa menjadi biodiesel belum diperoleh karena reaksi transesterifikasi minyak belum berhasil. Kendala lain yang membatasi perolehan hasil pada penelitian ini adalah terbatasnya bahan baku yang tersedia dan jumlah minyak yang dihasilkan dari bahan baku berupa bubuk rhizoma ginseng Jawa. Oleh karena itu, ada beberapa yang hal disarankan untuk dilakukan pada penelitian selanjutnya untuk mengatasi permasalahan tersebut yaitu sebagai berikut.

1. Dilakukan studi lebih lanjut mengenai jumlah katalis, jumlah alkohol, suhu reaksi dan waktu reaksi yang optimal untuk melangsungkan reaksi transesterifikasi pada minyak ginseng Jawa, sehingga dapat diketahui tingkat konversi minyaknya untuk menjadi biodiesel. Dalam hal ini, jika digunakan alat refluks juga perlu dilakukan studi mengenai suhu dan waktu transesterifikasi dengan alat refluks.
2. Dilakukan analisis kandungan minyak pada bahan baku ginseng Jawa disamping studi mengenai proses transesterifikasinya agar dapat diketahui potensi ginseng Jawa untuk dimanfaatkan sebagai biodiesel.
3. Melanjutkan pemanfaatan bahan baku yang sudah sering digunakan untuk memproduksi biodiesel secara lebih efisien seperti kelapa sawit dan jatropa, atau mencari alternatif bahan baku lain dengan kandungan minyak yang lebih banyak dari ginseng Jawa untuk menghasilkan biodiesel.
4. Selain memanfaatkan bahan baku lain, hal lain yang dapat dilakukan adalah meningkatkan produksi asam lemak pada rhizoma ginseng Jawa, misalnya melalui kultur jaringan (metode ini juga dapat mengatasi permasalahan seperti keterbatasan lahan karena dapat dilakukan dalam laboratorium dan menjadi alternatif untuk kultur alga dalam menyedikan minyak sebagai bahan baku biodiesel, tetapi perlu disertai penelitian terlebih dahulu untuk mengetahui cara yang efektif untuk menghasilkan asam lemak secara kultur jaringan menggunakan tanaman ginseng Jawa).

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LAMPIRAN

Lampiran 1. Pembuatan Larutan untuk Metode Esterifikasi BF_3-MeOH (AOAC, 2000)

1.1. Larutan 0,5 M NaOH-metanol (V=50 ml)

Gunakan sarung tangan karena bahan bersifat korosif. Timbang 1 g NaOH kemudian masukan ke dalam labu ukur 50 ml. Tambahkan metanol hingga tanda batas, kocok hingga NaOH terlarutkan sempurna. Pemanasan dapat dilakukan untuk mempercepat pelarutan, tetapi suhu perlu diperhatikan agar tidak melebihi 60^oC karena metanol akan menguap pada suhu 68^oC.

1.2. Larutan NaCl Jenuh

Panaskan akuades pada kompor hingga hangat. Jauhkan akuades dari kompor ketika sudah hangat dan larutkan bubuk NaCl ke dalam akuades yang masih hangat. Tambahkan bubuk NaCl hingga tidak terlarutkan lagi. Lakukan pemanasan kembali jika air sudah mulai dingin ketika hendak menambahkan bubuk NaCl.

1.3. Larutan 14% BF_3-metanol (V=50 ml) dari 20% BF_3

Gunakan sarung tangan karena bahan bersifat korosif. Masukkan 35 ml larutan 20% BF_3 ke dalam labu ukur 50 ml. Tambahkan metanol hingga tanda batas, kocok pelan hingga larutan tercampur sempurna. Lebih baik membuat larutan secukupnya agar sisa larutan bisa segera dibuang. Larutan BF_3 bersifat korosif dan bila disimpan pada gelas kaca biasa dapat merusak wadah tersebut.

Lampiran 2. Kebutuhan Bahan dalam Pembuatan Biodiesel (Gerpen dkk., 2004)

Berat minyak (Wminyak) = 9,8 ~ 10 g (dibulatkan)

2.1. Berat Metanol (WMeOH)

$$\text{W MeOH} = \frac{20 \times Wminyak}{100} = \frac{20 \times 10g}{100} = 2 \text{ g}$$

2.2. Berat NaOH (W NaOH)

$$\text{W NaOH} = \frac{0{,}3 \times Wminyak}{100} = \frac{0{,}3 \times 10g}{100} = 0{,}03 \text{ g}$$

2.3. Berat Asam (W H_2SO_4)

$$\text{W } H_2SO_4 = \frac{0{,}25 \times 10g}{100} = 0{,}025 \text{ g}$$

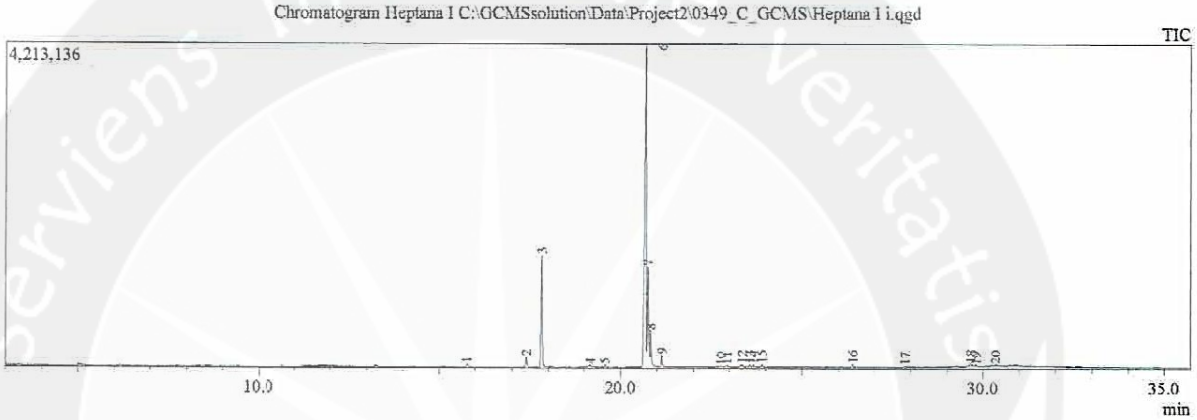
Lampiran 3. Hasil GC-MS Analisis Asam Lemak pada Minyak *T. paniculatum*

3.1. Ulangan 1

Sample Information

Analyzed by	: Admin
Analyzed	: 6/21/2016 2:00:45 PM
Sample Name	: Heptana I
Sample ID	:
Injection Volume	: 0.50
Data File	: C:\GCMSsolution\Data\Project2\0349_C_GCMS\Heptana I i.qgd
Tuning File	: C:\GCMSsolution\System\Tune1\Tuning 10052016.qgt

Chromatogram Heptana I C:\GCMSsolution\Data\Project2\0349_C_GCMS\Heptana I i.qgd



Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height
1	15.773	15.723	15.833	119688	0.51	43084
2	17.397	17.340	17.470	334914	1.44	128496
3	17.823	17.740	17.903	3848932	16.52	1460337
4	19.159	19.107	19.200	52223	0.22	18748
5	19.566	19.520	19.610	75064	0.32	32518
6	20.687	20.570	20.720	13199594	56.65	4190338
7	20.757	20.720	20.800	3157727	13.55	1284328
8	20.831	20.800	20.960	1190998	5.11	471051
9	21.135	21.087	21.200	352692	1.51	150169
10	22.775	22.727	22.840	47090	0.20	16848
11	22.941	22.887	22.987	48883	0.21	17851
12	23.364	23.273	23.453	161240	0.69	32706
13	23.570	23.540	23.620	88131	0.38	36778
14	23.666	23.620	23.733	68591	0.29	27053
15	23.903	23.853	23.953	95762	0.41	41563
16	26.404	26.333	26.467	115290	0.49	43060
17	27.856	27.800	27.933	53704	0.23	17907
18	29.661	29.593	29.740	144872	0.62	29559
19	29.813	29.740	29.900	72636	0.31	14951
20	30.343	30.273	30.427	71045	0.30	16710
				23299076	100.00	8074055

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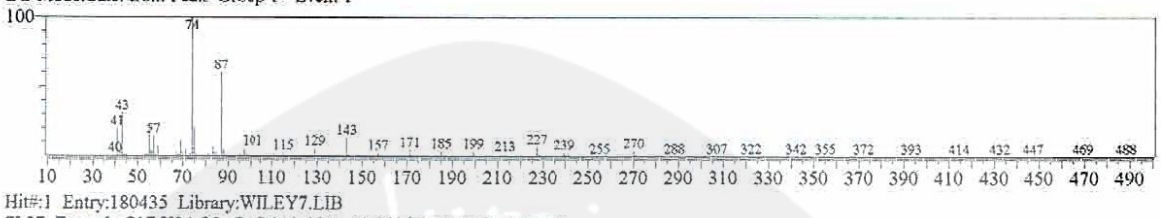

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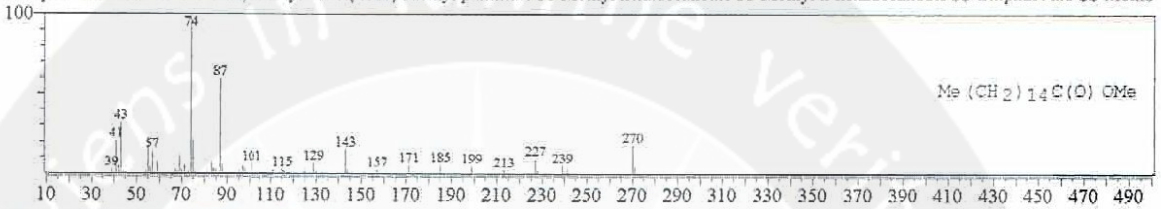

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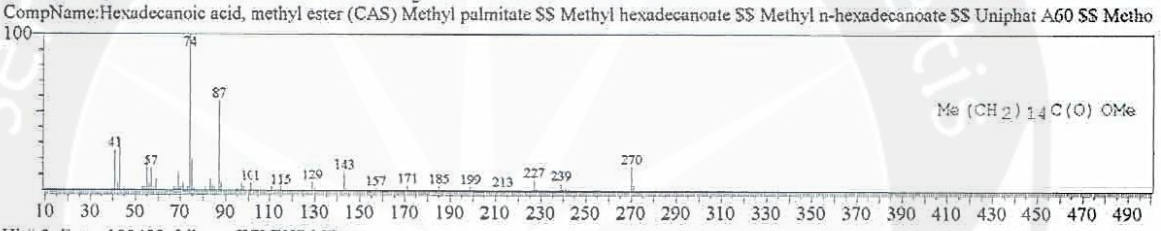

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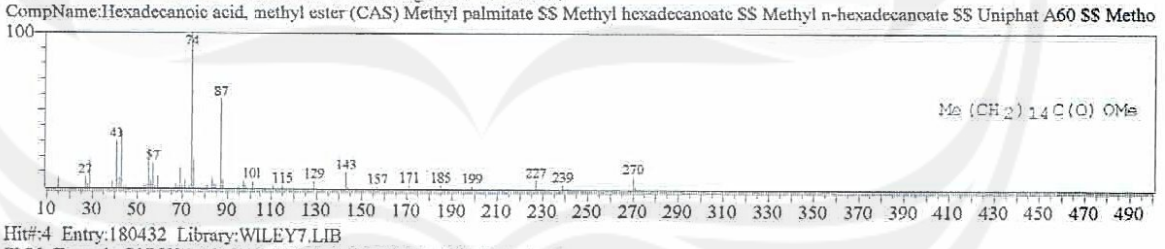

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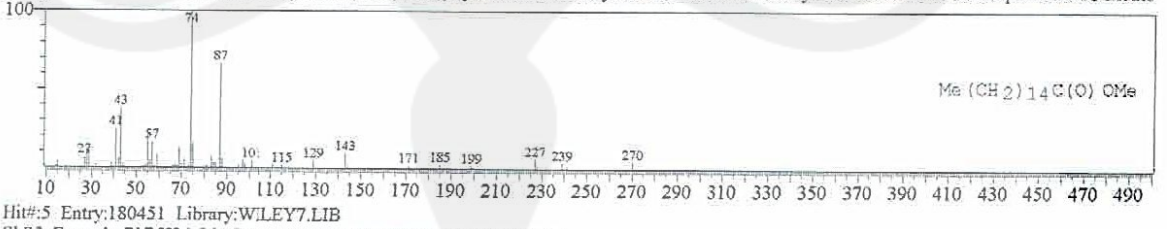

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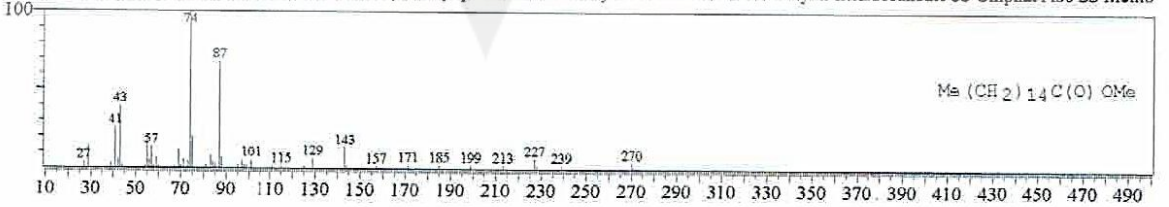

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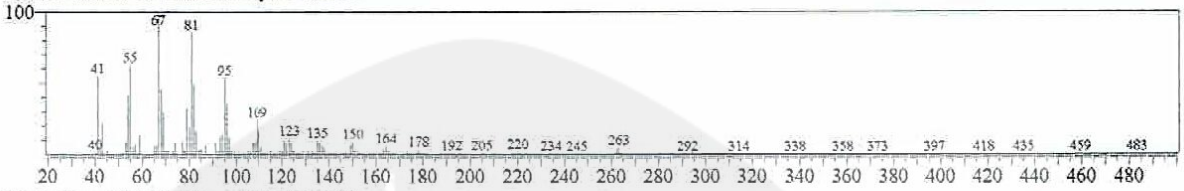

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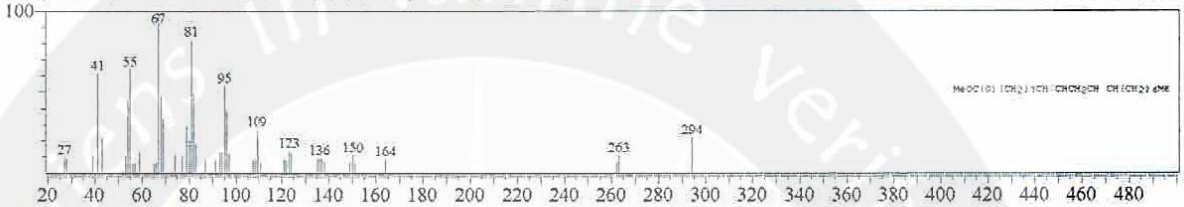

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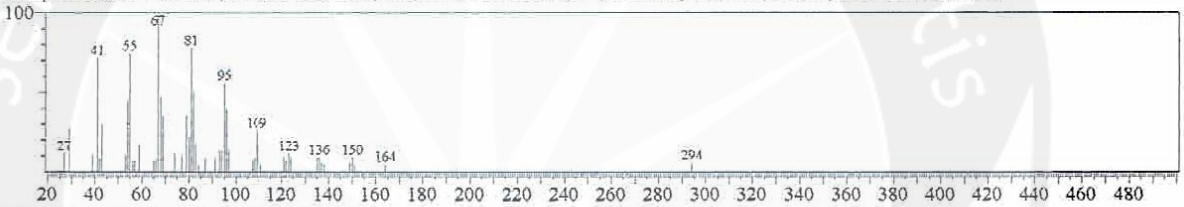

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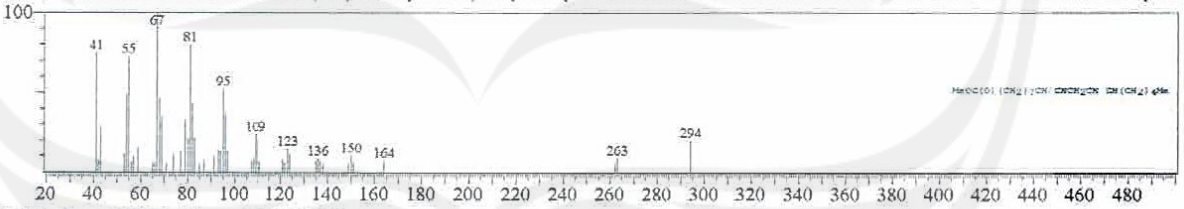

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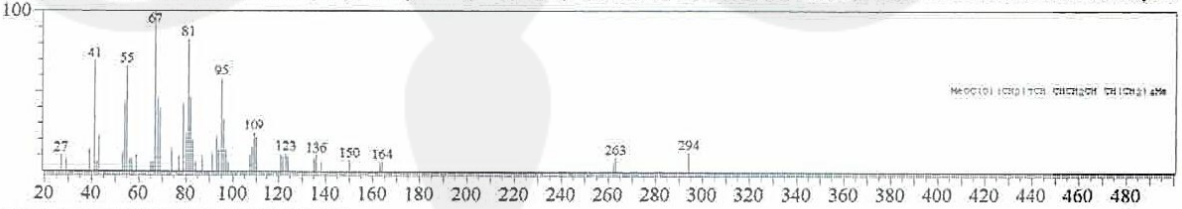
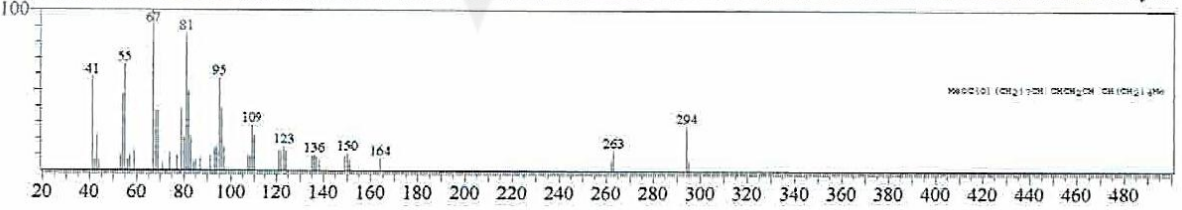
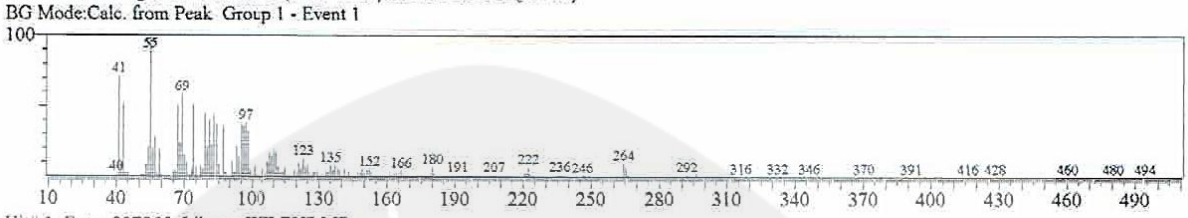
SI:95 Formula:C19 H34 O2 CAS:112-63-0 MolWeight:294 RetIndex:0
CompName:9,12-Octadecadienoic acid (Z,Z)-, methyl ester (CAS) Methyl linoleate $$ METHYL CIS-9,CIS-12-OCTADECADIENOATE $$ Methyl oc



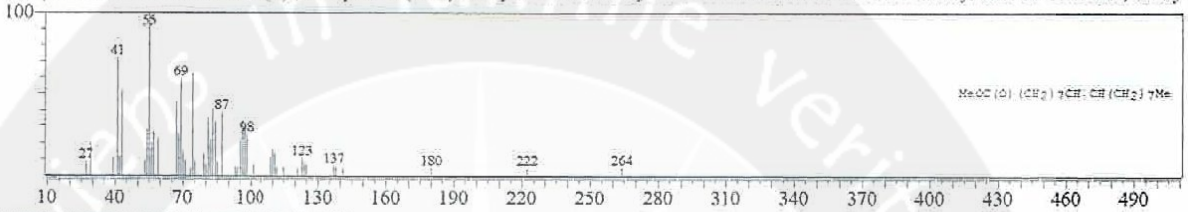
Hit#:5 Entry:205818 Library:WILEY7.LIB
SI:94 Formula:C19 H34 O2 CAS:112-63-0 MolWeight:294 RetIndex:0
CompName:9,12-Octadecadienoic acid (Z,Z)-, methyl ester (CAS) Methyl linoleate $$ METHYL CIS-9,CIS-12-OCTADECADIENOATE $$ Methyl oc



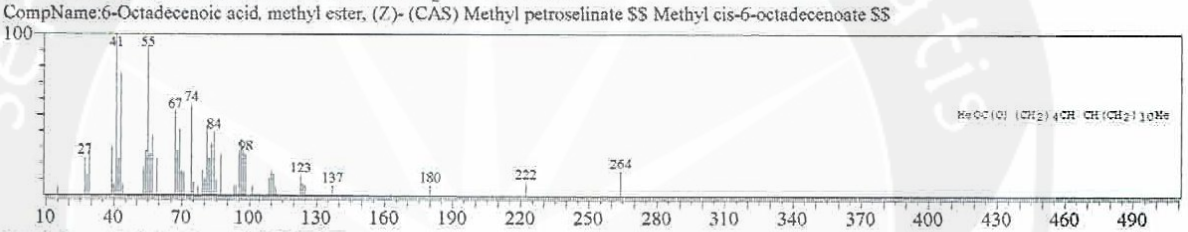
<< Target >>
Line#:7 R.Time:20.757(Scan#:5328) MassPeaks:338
RawMode:Averaged 20.753-20.760(5327-5329) BasePeak:55.00(81745)
BG Mode:Calc. from Peak Group 1 - Event 1



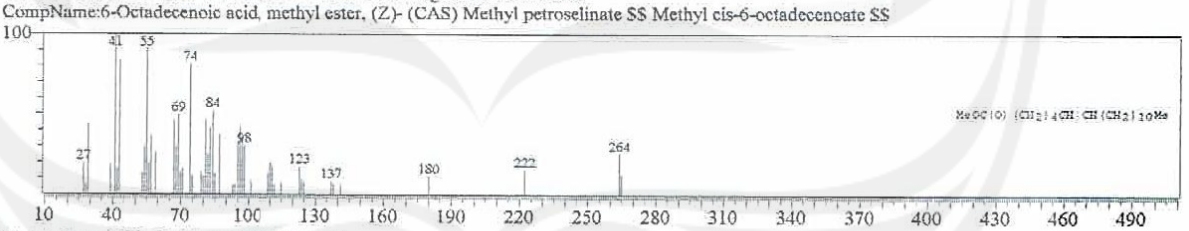
Hit#:1 Entry:207865 Library:WILEY7.LIB
SI:92 Formula:C19 H36 O2 CAS:112-62-9 MolWeight:296 RetIndex:0
CompName:9-Octadecenoic acid (Z)-, methyl ester (CAS) Methyl oleate $$ Methyl cis-9-octadecenoate $$ Oleic acid methyl ester $$ **Oleic acid, methy**



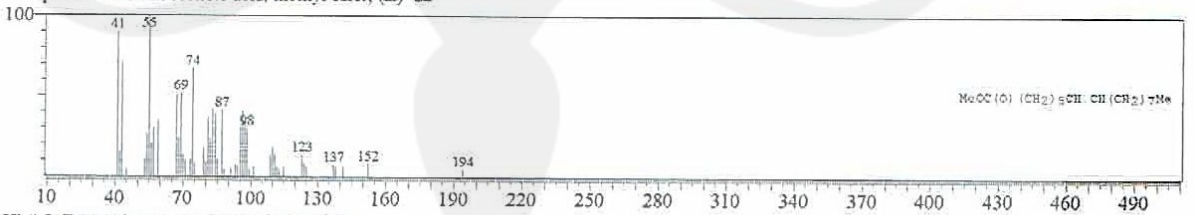
Hit#:2 Entry:207847 Library:WILEY7.LIB
SI:91 Formula:C19 H36 O2 CAS:2777-58-4 MolWeight:296 RetIndex:0
CompName:6-Octadecenoic acid, methyl ester, (Z)- (CAS) Methyl petroselinate $$ Methyl cis-6-octadecenoate $$



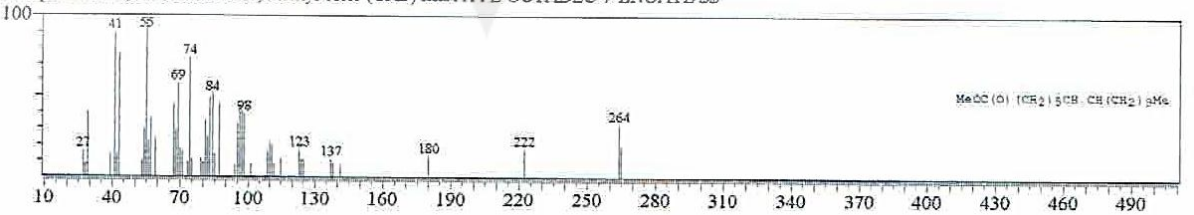
Hit#:3 Entry:207846 Library:WILEY7.LIB
SI:90 Formula:C19 H36 O2 CAS:2777-58-4 MolWeight:296 RetIndex:0
CompName:6-Octadecenoic acid, methyl ester, (Z)- (CAS) Methyl petroselinate $$ Methyl cis-6-octadecenoate $$



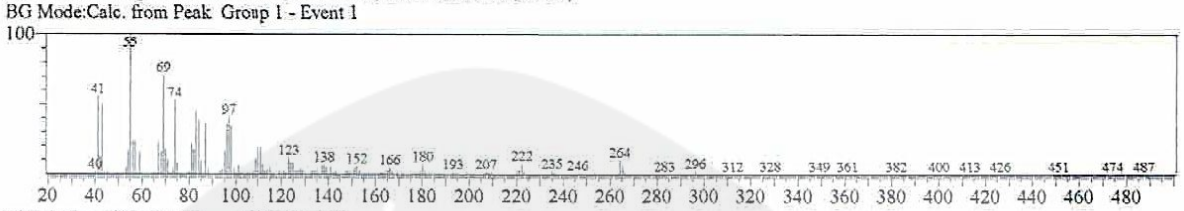
Hit#:4 Entry:177667 Library:WILEY7.LIB
SI:89 Formula:C17 H32 O2 CAS:56875-67-3 MolWeight:268 RetIndex:0
CompName:7-Hexadecenoic acid, methyl ester, (Z)- $$



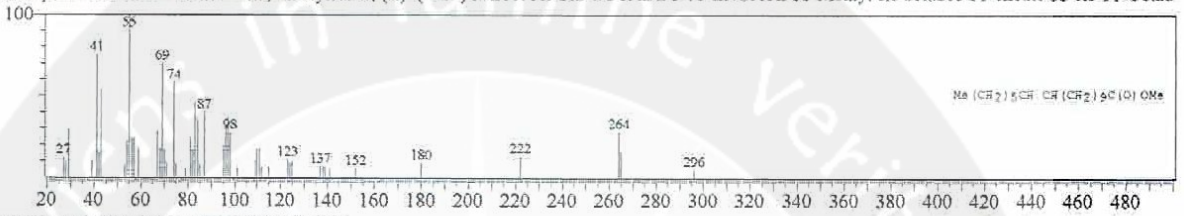
Hit#:5 Entry:207514 Library:WILEY7.LIB
SI:89 Formula:C19 H36 O2 CAS:57396-98-2 MolWeight:296 RetIndex:0
CompName:7-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-7-ENOATE $$



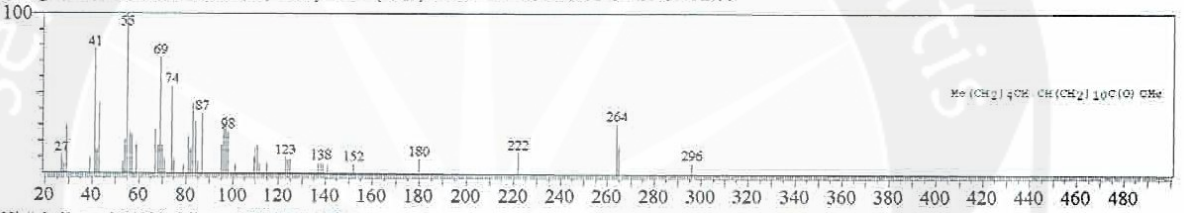
<< Target >>
Line#:8 R.Time:20.830(Scan#:5350) MassPeaks:333
RawMode:Averaged 20.827-20.833(5349-5351) BasePeak:55.00(33759)
BG Mode:Calc. from Peak Group 1 - Event 1



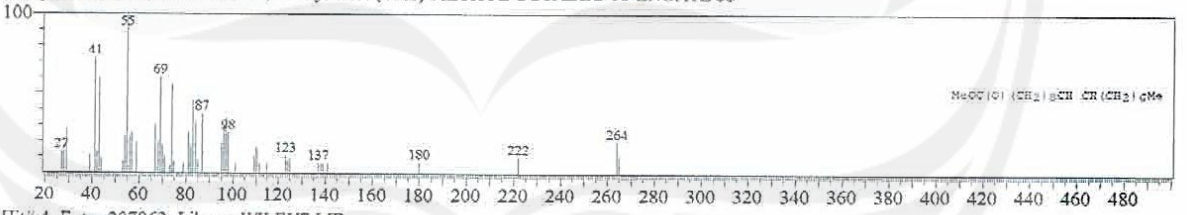
Hit#:1 Entry:207531 Library:WILEY7.LIB
SI:95 Formula:C19 H36 O2 CAS:1937-63-9 MolWeight:296 RetIndex:0
CompName:11-Octadecenoic acid, methyl ester, (Z)- (CAS) METHYL CIS OCTADEC-11-ENOATE $$ Methyl cis-octadec-11-enoate $$ cis-11-Octad



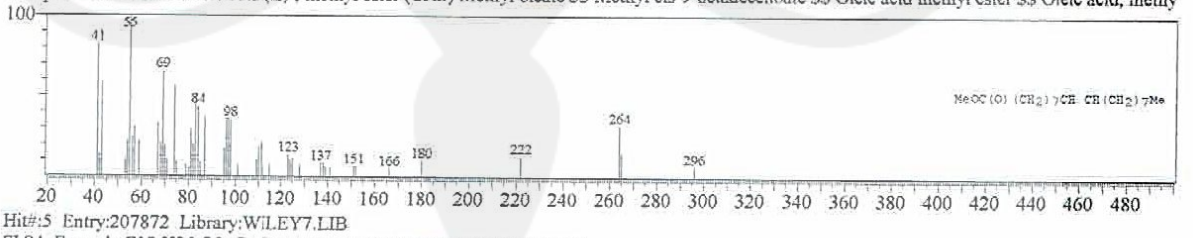
Hit#:2 Entry:207532 Library:WILEY7.LIB
SI:95 Formula:C19 H36 O2 CAS:56554-46-2 MolWeight:296 RetIndex:0
CompName:12-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-12-ENOATE $$



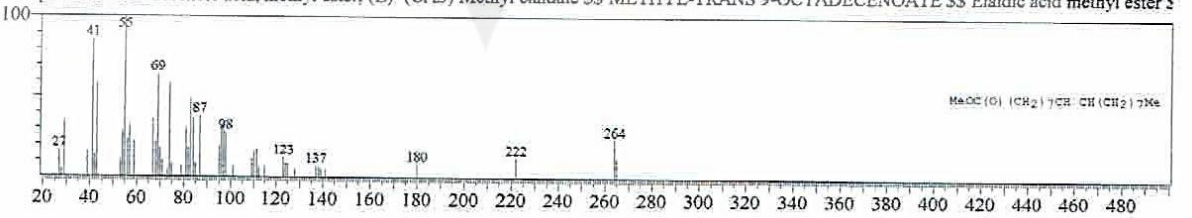
Hit#:3 Entry:207529 Library:WILEY7.LIB
SI:94 Formula:C19 H36 O2 CAS:13481-95-3 MolWeight:296 RetIndex:0
CompName:10-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-10-ENOATE $$



Hit#:4 Entry:207863 Library:WILEY7.LIB
SI:94 Formula:C19 H36 O2 CAS:112-62-9 MolWeight:296 RetIndex:0
CompName:9-Octadecenoic acid (Z)-, methyl ester (CAS) Methyl oleate $$ Methyl cis-9-octadecenoate $$ Oleic acid methyl ester $$ Oleic acid, methy



Hit#:5 Entry:207872 Library:WILEY7.LIB
SI:94 Formula:C19 H36 O2 CAS:1937-62-8 MolWeight:296 RetIndex:0
CompName:9-Octadecenoic acid, methyl ester, (E)- (CAS) Methyl elaidate $$ METHYL-TRANS 9-OCTADECENOATE $$ Elaidic acid methyl ester $

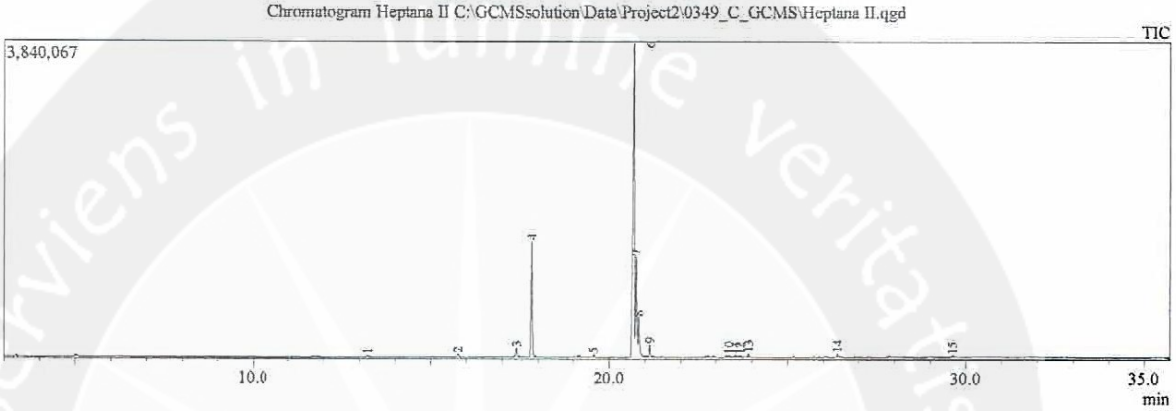


3.2. Ulangan 2

Sample Information

Analyzed by	: Admin
Analyzed	: 6/21/2016 11:05:34 AM
Sample Name	: Heptana II
Sample ID	: 2
Injection Volume	: 0.50
Data File	: C:\GCMSsolution\Data\Project2\0349_C_GCMS\Heptana II.qgd
Tuning File	: C:\GCMSsolution\System\Tune1\Tuning 10052016.qgt

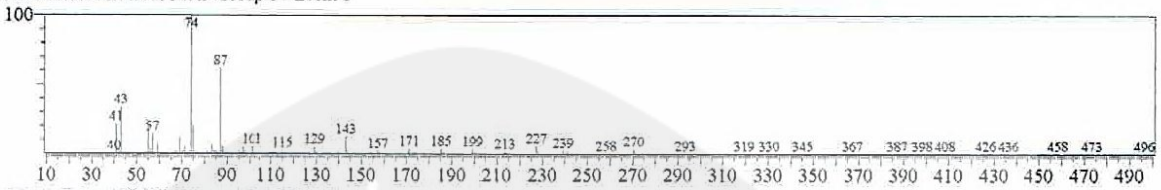
Chromatogram Heptana II C:\GCMSsolution\Data\Project2\0349_C_GCMS\Heptana II.qgd



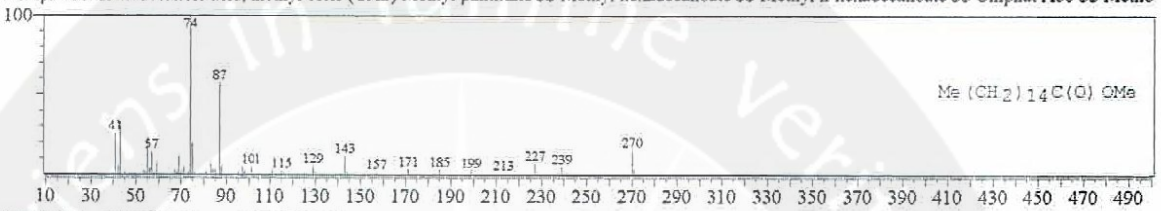
Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height
1	13.231	13.183	13.290	59585	0.28	21022
2	15.772	15.730	15.817	114592	0.53	41901
3	17.395	17.343	17.457	256396	1.18	104305
4	17.825	17.740	17.923	3758015	17.36	1398151
5	19.561	19.520	19.610	65382	0.30	29799
6	20.686	20.573	20.717	12085417	55.84	3812245
7	20.756	20.717	20.797	3113005	14.38	1228525
8	20.829	20.797	20.963	1281902	5.92	485160
9	21.133	21.070	21.270	385411	1.78	150295
10	23.359	23.270	23.423	98623	0.46	22650
11	23.565	23.537	23.610	60790	0.28	26099
12	23.660	23.610	23.730	55211	0.26	19536
13	23.902	23.837	23.983	101244	0.47	41370
14	26.402	26.343	26.497	122895	0.57	43268
15	29.628	29.570	29.717	85054	0.39	22259
				21643522	100.00	7446585

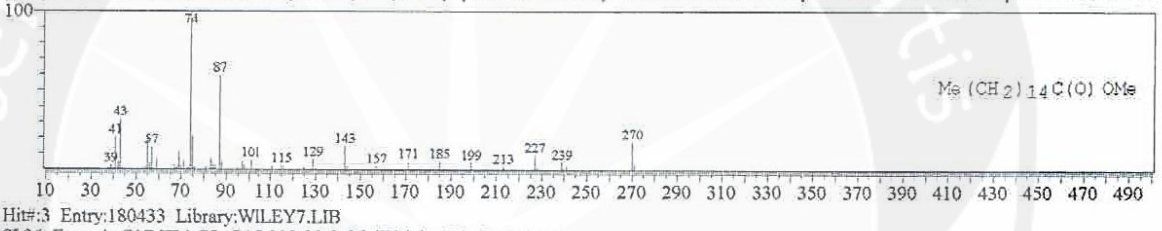
<< Target >>
Line#:4 R.Time:17.823(Scan#:4448) MassPeaks:307
RawMode:Averaged 17.820-17.827(4447-4449) BasePeak:74.00(334448)
BG Mode:Calc. from Peak Group 1 - Event 1



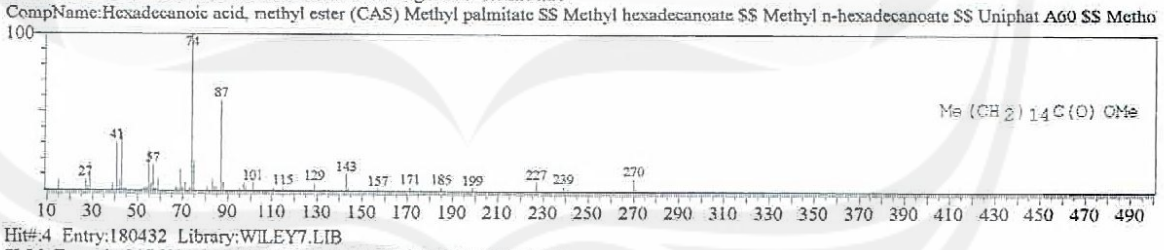
Hit#:1 Entry:180438 Library:WILEY7.LIB
SI:97 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate SS Methyl hexadecanoate SS Methyl n-hexadecanoate SS Uniphat A60 SS Metho



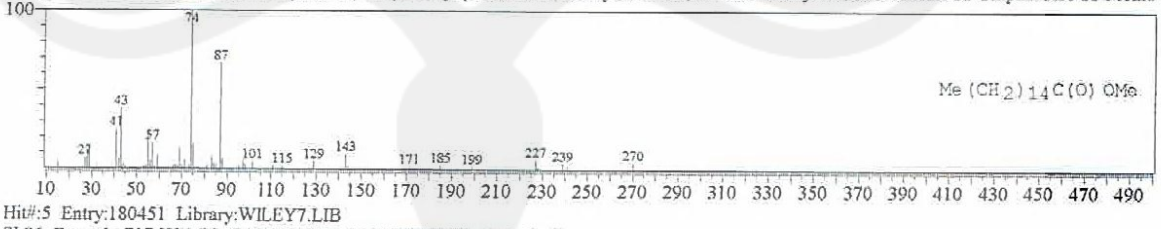
Hit#:2 Entry:180435 Library:WILEY7.LIB
SI:97 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate SS Methyl hexadecanoate SS Methyl n-hexadecanoate SS Uniphat A60 SS Metho



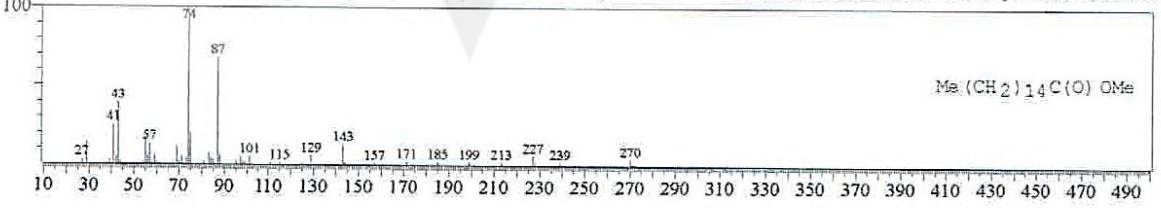
Hit#:3 Entry:180433 Library:WILEY7.LIB
SI:96 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate SS Methyl hexadecanoate SS Methyl n-hexadecanoate SS Uniphat A60 SS Metho



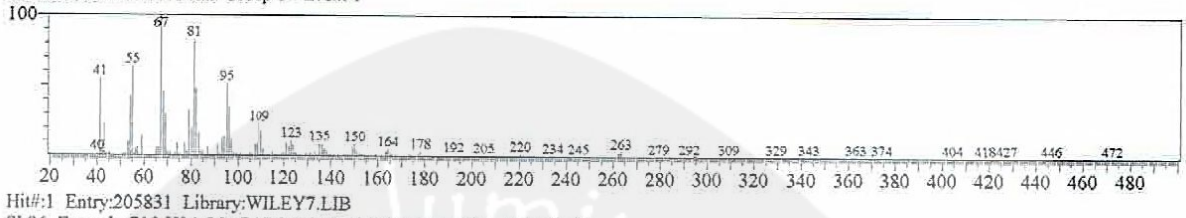
Hit#:4 Entry:180432 Library:WILEY7.LIB
SI:96 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate SS Methyl hexadecanoate SS Methyl n-hexadecanoate SS Uniphat A60 SS Metho



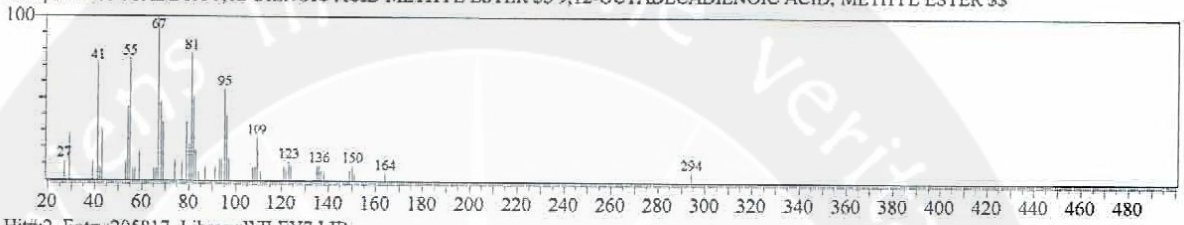
Hit#:5 Entry:180451 Library:WILEY7.LIB
SI:96 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate SS Methyl hexadecanoate SS Methyl n-hexadecanoate SS Uniphat A60 SS Metho



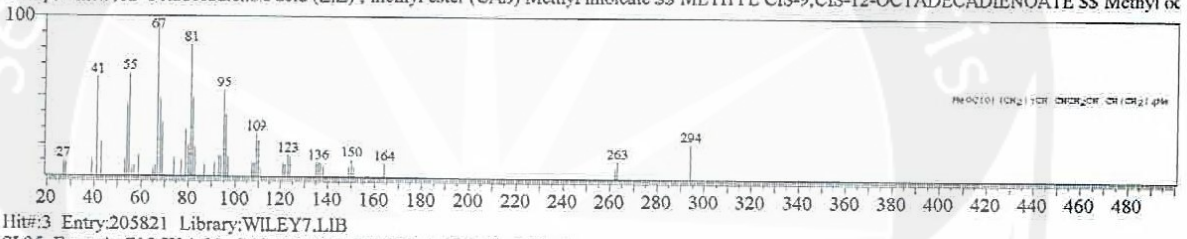
<< Target >>
Line#:6 R.Time:20.687(Scan#:5307) MassPeaks:339
RawMode:Averaged 20.683-20.590(5306-5308) BasePeak:67.00(350990)
BG Mode:Calc. from Peak Group 1 - Event 1



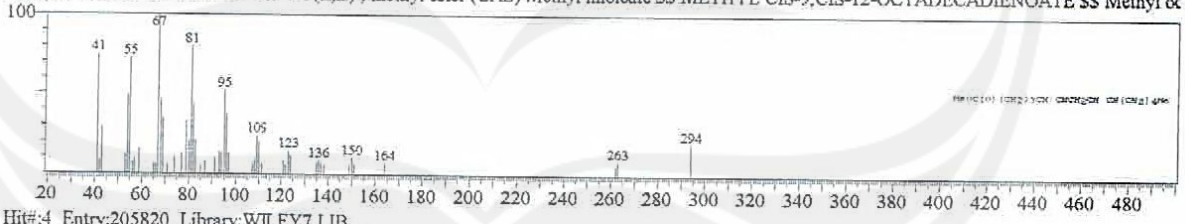
Hit#:1 Entry:205831 Library:WILEY7.LIB
SI:96 Formula:C19 H34 O2 CAS:2462-85-3 MolWeight:294 RetIndex:0
CompName:OCTADECA-9,12-DIENOIC ACID METHYL ESTER $$ 9,12-OCTADECADIENOIC ACID, METHYL ESTER $$



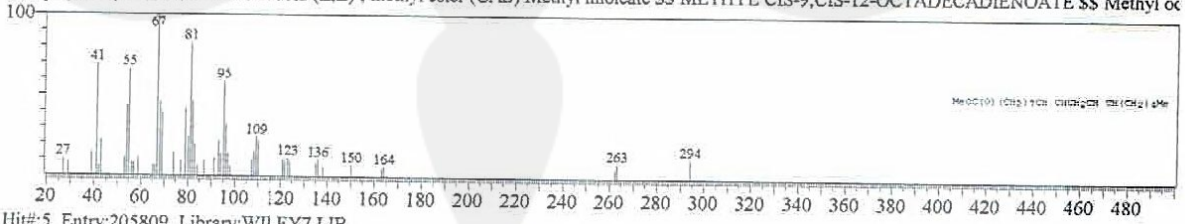
Hit#:2 Entry:205817 Library:WILEY7.LIB
SI:96 Formula:C19 H34 O2 CAS:112-63-0 MolWeight:294 RetIndex:0
CompName:9,12-Octadecadienoic acid (Z,Z)-, methyl ester (CAS) Methyl linoleate $$ METHYL CIS-9,CIS-12-OCTADECADIENOATE $$ Methyl oc



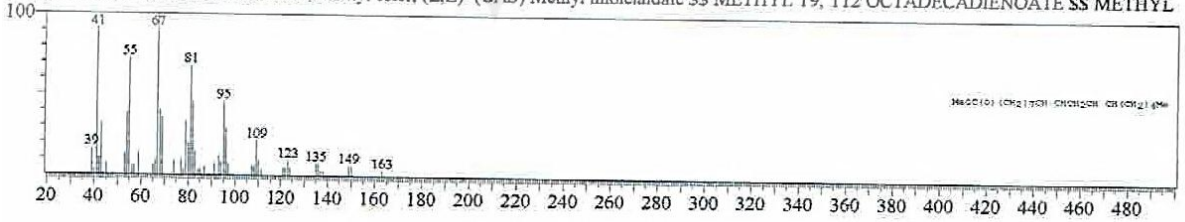
Hit#:3 Entry:205821 Library:WILEY7.LIB
SI:95 Formula:C19 H34 O2 CAS:112-63-0 MolWeight:294 RetIndex:0
CompName:9,12-Octadecadienoic acid (Z,Z)-, methyl ester (CAS) Methyl linoleate $$ METHYL CIS-9,CIS-12-OCTADECADIENOATE $$ Methyl oc



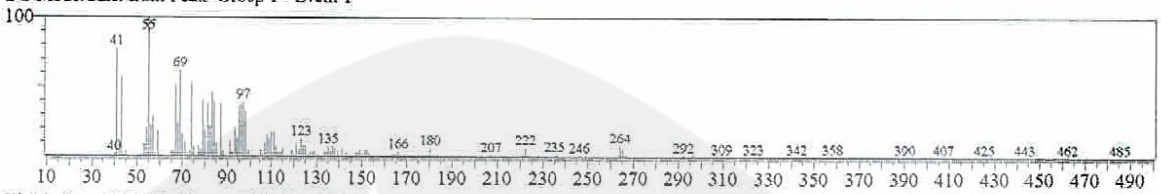
Hit#:4 Entry:205820 Library:WILEY7.LIB
SI:95 Formula:C19 H34 O2 CAS:112-63-0 MolWeight:294 RetIndex:0
CompName:9,12-Octadecadienoic acid (Z,Z)-, methyl ester (CAS) Methyl linoleate $$ METHYL CIS-9,CIS-12-OCTADECADIENOATE $$ Methyl oc



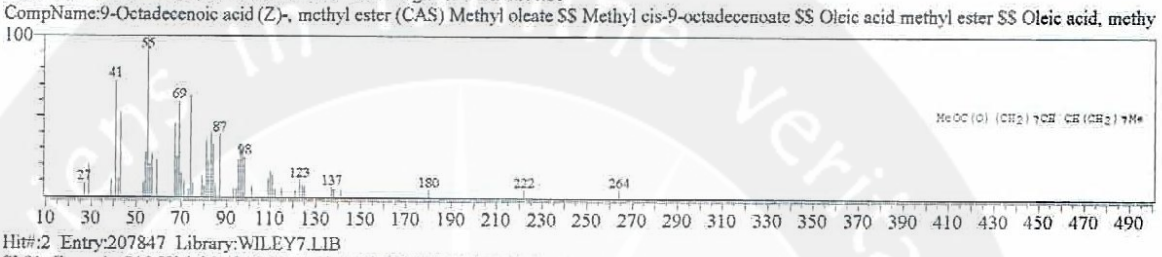
Hit#:5 Entry:205809 Library:WILEY7.LIB
SI:95 Formula:C19 H34 O2 CAS:2566-97-4 MolWeight:294 RetIndex:0
CompName:9,12-Octadecadienoic acid, methyl ester, (E,E)- (CAS) Methyl linolelaidate $$ METHYL T9, T12 OCTADECADIENOATE $$ METHYL



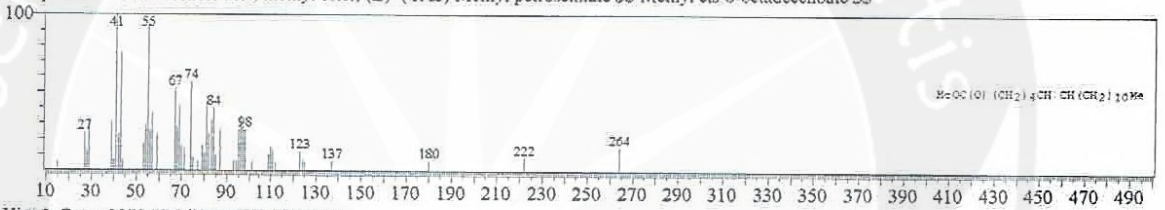
<< Target >>
Line#:7 R.Time:20.757(Scan#:5328) MassPeaks:347
RawMode:Averaged 20.753-20.760(5327-5329) BasePeak:55.00(73457)
BG Mode:Calc. from Peak Group 1 - Event 1



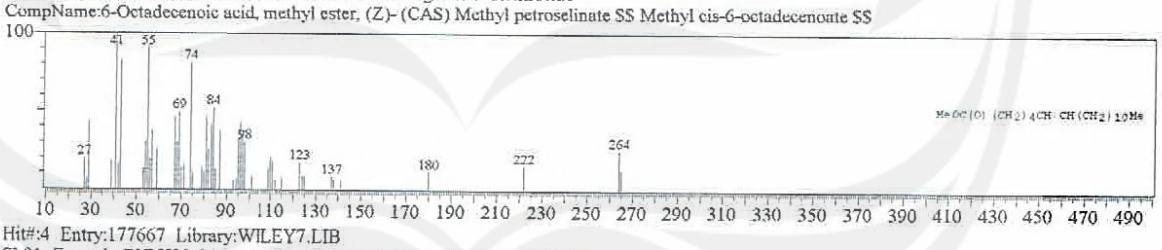
Hit#:1 Entry:207865 Library:WILEY7.LIB
SI:93 Formula:C19 H36 O2 CAS:112-62-9 MolWeight:296 RetIndex:0
CompName:9-Octadecenoic acid (Z)-, methyl ester (CAS) Methyl oleate $$ Methyl cis-9-octadecenoate $$ Oleic acid methyl ester $$ Oleic acid, methy



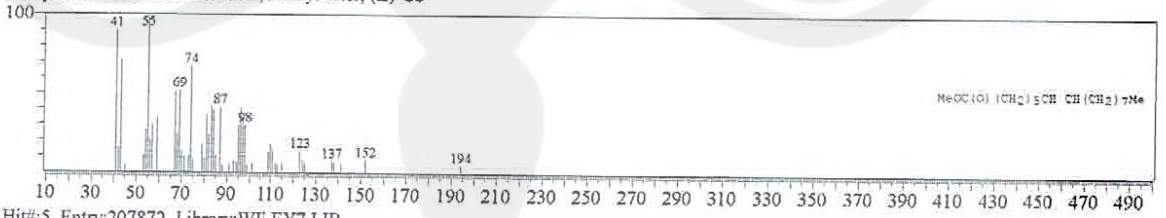
Hit#:2 Entry:207847 Library:WILEY7.LIB
SI:91 Formula:C19 H36 O2 CAS:2777-58-4 MolWeight:296 RetIndex:0
CompName:6-Octadecenoic acid, methyl ester, (Z)- (CAS) Methyl petroselinate $$ Methyl cis-6-octadecenoate $$



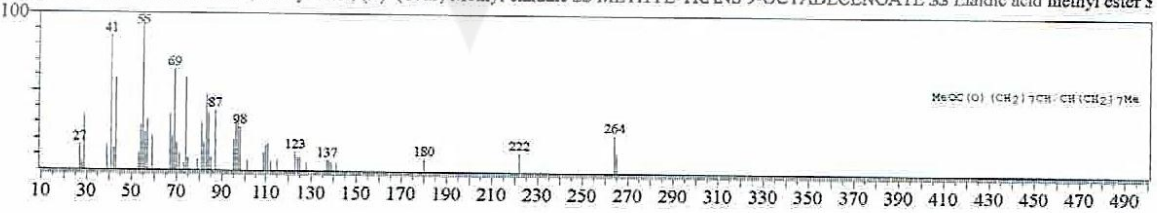
Hit#:3 Entry:207846 Library:WILEY7.LIB
SI:91 Formula:C19 H36 O2 CAS:2777-58-4 MolWeight:296 RetIndex:0
CompName:6-Octadecenoic acid, methyl ester, (Z)- (CAS) Methyl petroselinate $$ Methyl cis-6-octadecenoate $$



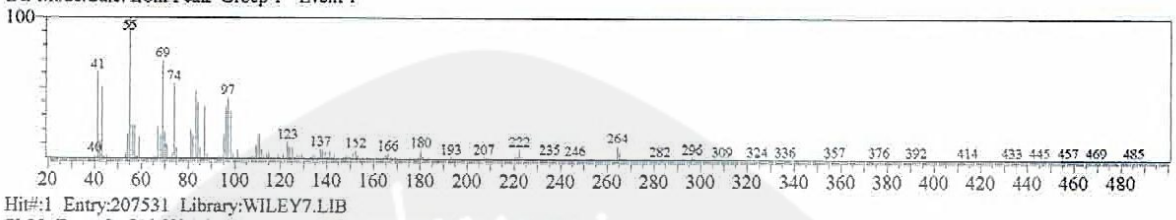
Hit#:4 Entry:177667 Library:WILEY7.LIB
SI:91 Formula:C17 H32 O2 CAS:56875-67-3 MolWeight:268 RetIndex:0
CompName:7-Hexadecenoic acid, methyl ester, (Z)- $$



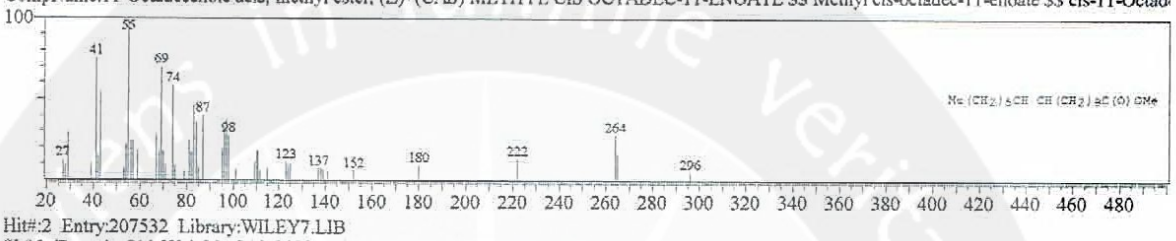
Hit#:5 Entry:207872 Library:WILEY7.LIB
SI:90 Formula:C19 H36 O2 CAS:1937-62-8 MolWeight:296 RetIndex:0
CompName:9-Octadecenoic acid, methyl ester, (E)- (CAS) Methyl elaidate $$ METHYL-TRANS 9-OCTADECENOATE $$ Elaidic acid methyl ester $



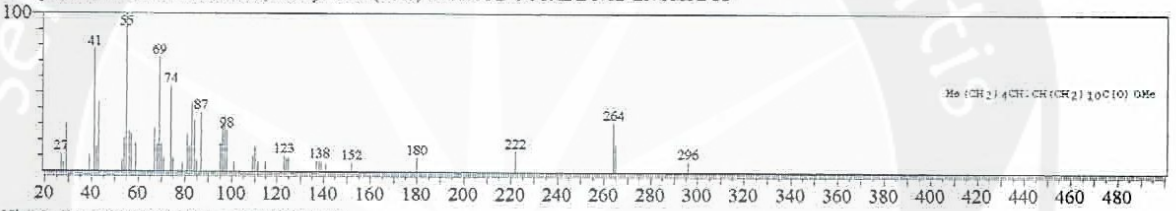
<< Target >>
Line#:8 R.Time:20.830(Scan#:5350) MassPeaks:311
RawMode:Averaged 20.827-20.833(5349-5351) BasePeak:55.00(33477)
BG Mode:Calc. from Peak Group 1 - Event 1



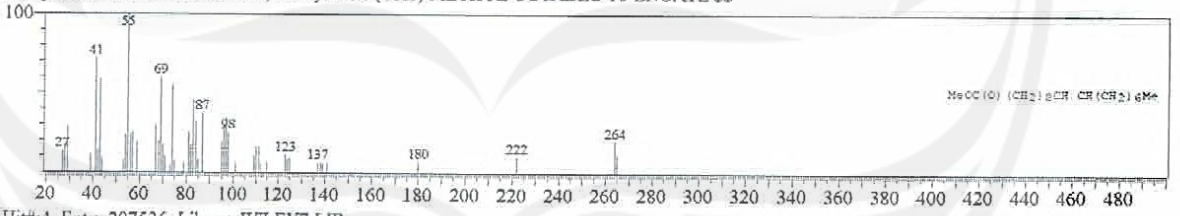
Hit#:1 Entry:207531 Library:WILEY7.LIB
SI:95 Formula:C19 H36 O2 CAS:1937-63-9 MolWeight:296 RetIndex:0
CompName:11-Octadecenoic acid, methyl ester, (Z)- (CAS) METHYL CIS OCTADEC-11-ENOATE $$ Methyl cis-octadec-11-enoate $$ cis-11-Octad



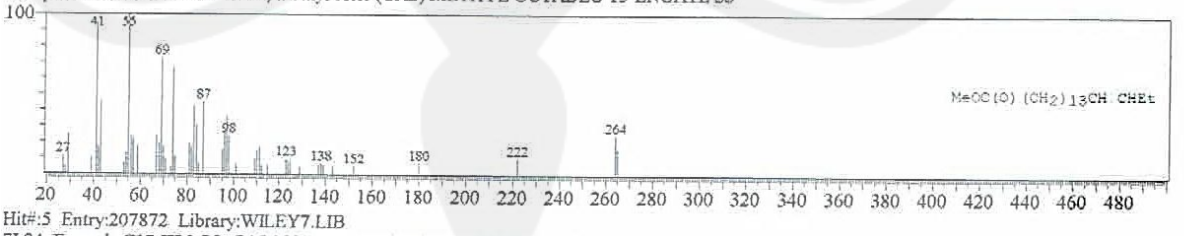
Hit#:2 Entry:207532 Library:WILEY7.LIB
SI:95 Formula:C19 H36 O2 CAS:56554-46-2 MolWeight:296 RetIndex:0
CompName:12-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-12-ENOATE $$



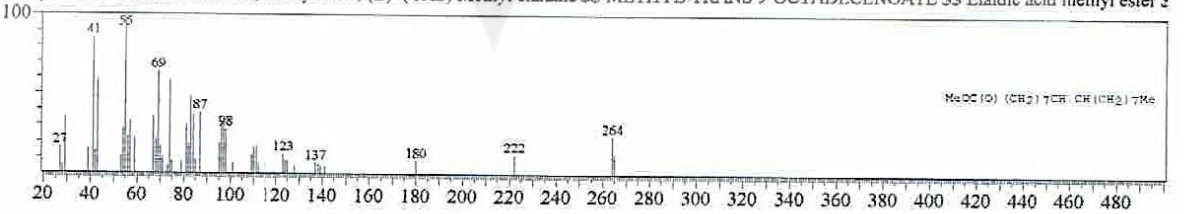
Hit#:3 Entry:207529 Library:WILEY7.LIB
SI:95 Formula:C19 H36 O2 CAS:13481-95-3 MolWeight:296 RetIndex:0
CompName:10-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-10-ENOATE $$



Hit#:4 Entry:207536 Library:WILEY7.LIB
SI:94 Formula:C19 H36 O2 CAS:4764-72-1 MolWeight:296 RetIndex:0
CompName:15-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-15-ENOATE $$



Hit#:5 Entry:207872 Library:WILEY7.LIB
SI:94 Formula:C19 H36 O2 CAS:1937-62-8 MolWeight:296 RetIndex:0
CompName:9-Octadecenoic acid, methyl ester, (E)- (CAS) Methyl elaidate $$ METHYL-TRANS 9-OCTADECENOATE $$ Elaidic acid methyl ester $

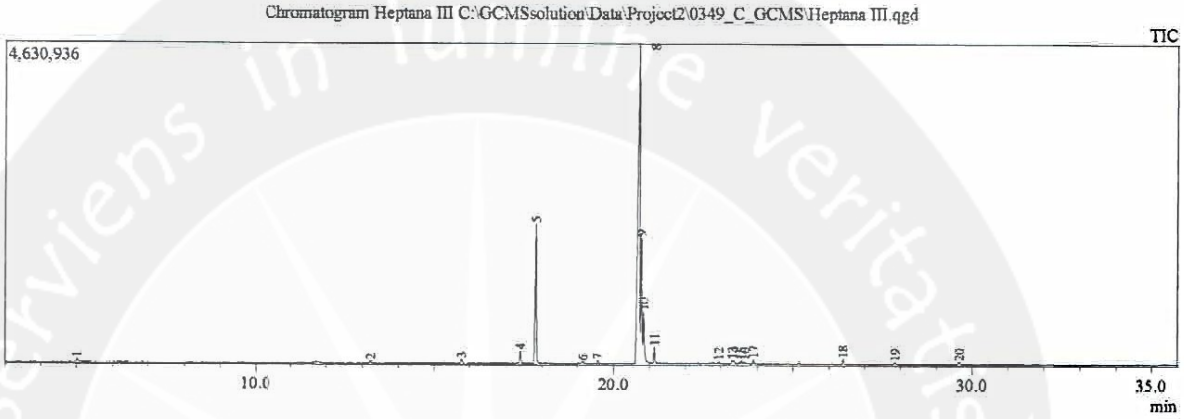


3.3. Ulangan 3

Sample Information

Analyzed by	: Admin
Analyzed	: 6/21/2016 11:43:53 AM
Sample Name	: Heptana III
Sample ID	: 3
Injection Volume	: 0.50
Data File	: C:\GCMSsolution\Data\Project2\0349_C_GCMS\Heptana III.qgd
Tuning File	: C:\GCMSsolution\System\Tune1\Tuning 10052016.qgt

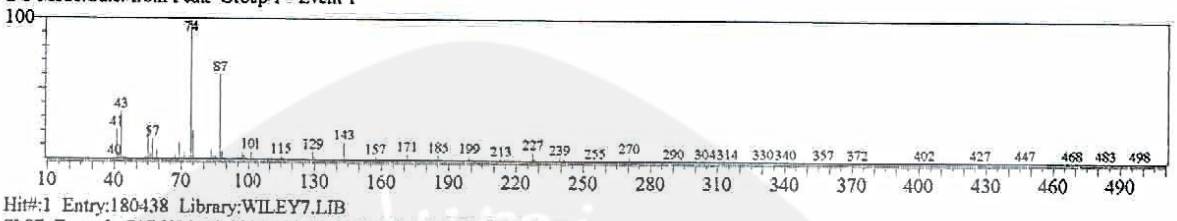
Chromatogram Heptana III C:\GCMSsolution\Data\Project2\0349_C_GCMS\Heptana III.qgd



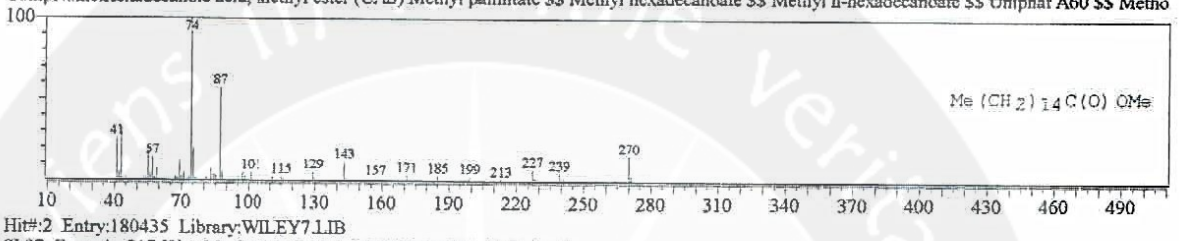
Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height
1	5.005	4.953	5.077	140731	0.42	48078
2	13.235	13.183	13.303	108646	0.33	32483
3	15.768	15.713	15.830	178650	0.54	62938
4	17.391	17.330	17.450	472171	1.42	182325
5	17.827	17.747	17.920	5537210	16.71	2023874
6	19.156	19.093	19.200	93981	0.28	29794
7	19.560	19.510	19.607	109412	0.33	48374
8	20.709	20.570	20.737	18240882	55.04	4594049
9	20.770	20.737	20.810	4601134	13.88	1843185
10	20.838	20.810	21.070	2029183	6.12	745701
11	21.133	21.070	21.230	552050	1.67	226381
12	22.936	22.877	22.983	70809	0.21	26947
13	23.310	23.250	23.330	100909	0.30	45346
14	23.355	23.330	23.450	141419	0.43	52171
15	23.566	23.530	23.617	110528	0.33	42111
16	23.659	23.617	23.743	93592	0.28	33837
17	23.899	23.843	23.983	158909	0.48	63300
18	26.402	26.337	26.477	178359	0.54	68934
19	27.854	27.783	27.917	76235	0.23	23953
20	29.635	29.550	29.743	148556	0.45	35579
				33143366	100.00	10229360

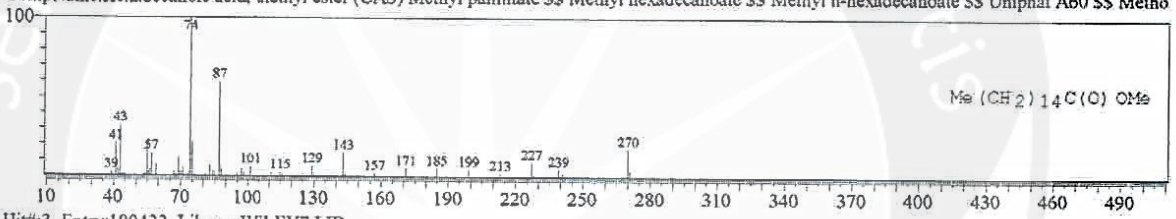
<< Target >>
Line#:5 R.Time:17.827(Scan#:4449) MassPeaks:324
RawMode:Averaged 17.823-17.830(4448-4450) BasePeak:74.00(472610)
BG Mode:Calc. from Peak Group 1 - Event 1



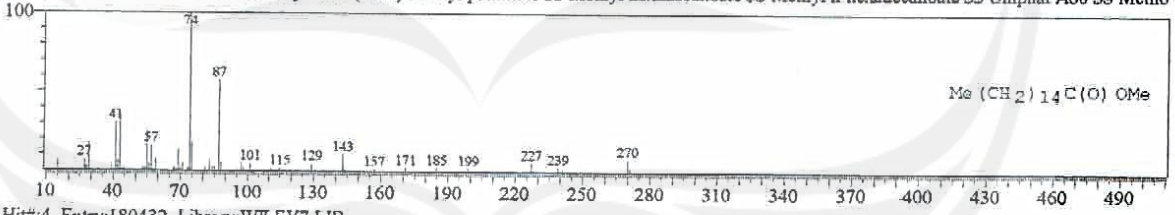
Hit#:1 Entry:180438 Library:WILEY7.LIB
SI:97 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate $$ Methyl hexadecanoate $$ Methyl n-hexadecanoate $$ Uniphat A60 $$ Metho



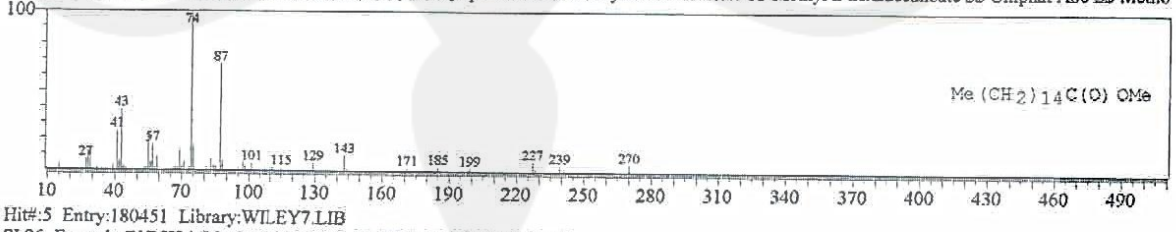
Hit#:2 Entry:180435 Library:WILEY7.LIB
SI:97 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate $$ Methyl hexadecanoate $$ Methyl n-hexadecanoate $$ Uniphat A60 $$ Metho



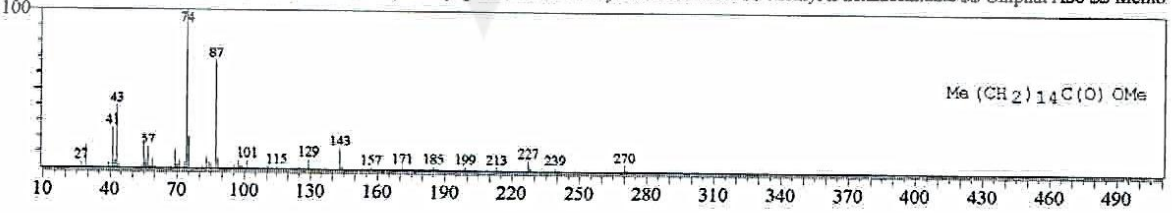
Hit#:3 Entry:180433 Library:WILEY7.LIB
SI:96 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate $$ Methyl hexadecanoate $$ Methyl n-hexadecanoate $$ Uniphat A60 $$ Metho



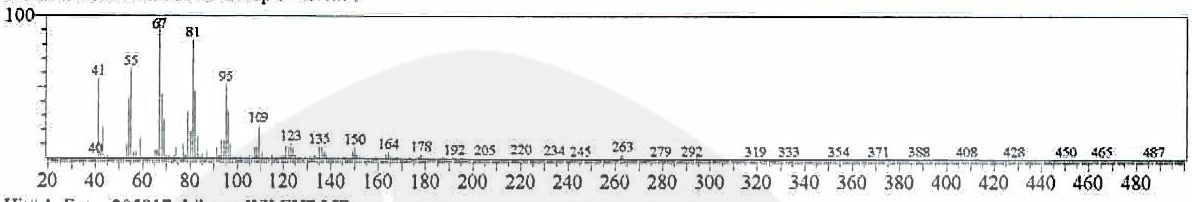
Hit#:4 Entry:180432 Library:WILEY7.LIB
SI:96 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate $$ Methyl hexadecanoate $$ Methyl n-hexadecanoate $$ Uniphat A60 $$ Metho



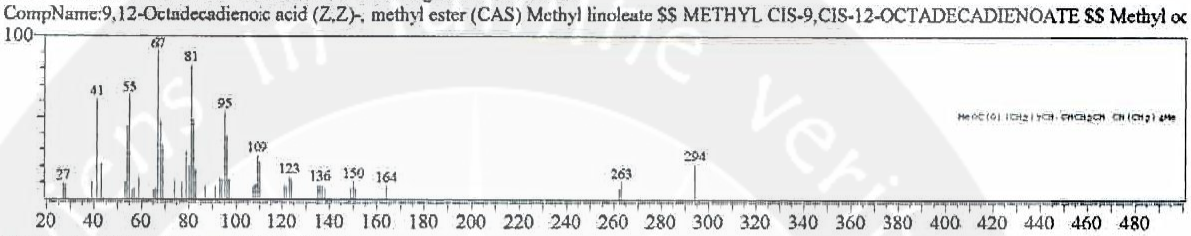
Hit#:5 Entry:180451 Library:WILEY7.LIB
SI:96 Formula:C17 H34 O2 CAS:112-39-0 MolWeight:270 RetIndex:0
CompName:Hexadecanoic acid, methyl ester (CAS) Methyl palmitate $$ Methyl hexadecanoate $$ Methyl n-hexadecanoate $$ Uniphat A60 $$ Metho



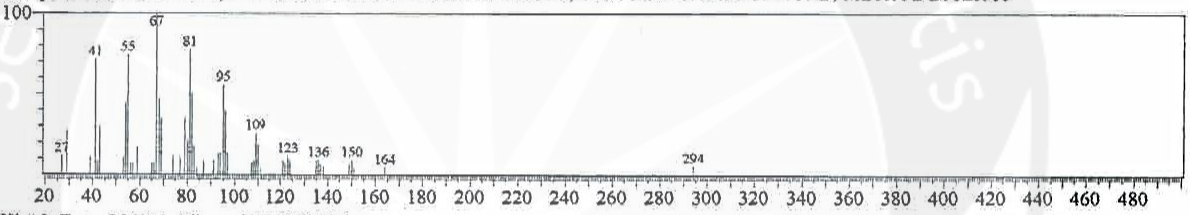
<< Target >>
Line#:8 R.Time:20.710(Scan#:5314) MassPeaks:317
RawMode:Averaged 20.707-20.713(5313-5315) BasePeak:67.00(412991)
BG Mode:Calc. from Peak Group 1 - Event 1



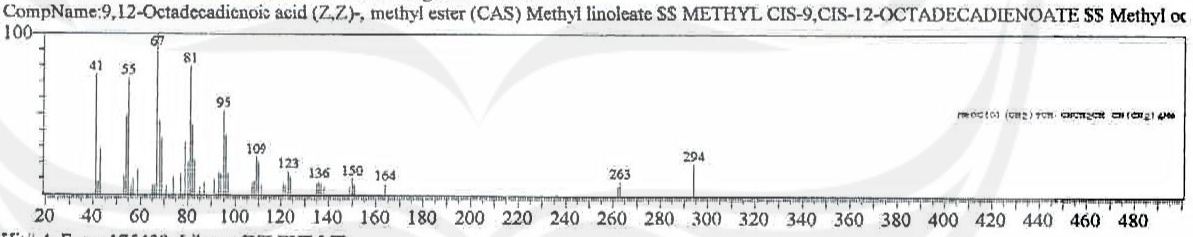
Hit#:1 Entry:205817 Library:WILEY7.LIB
SI:96 Formula:C19 H34 O2 CAS:112-63-0 MolWeight:294 RetIndex:0
CompName:9,12-Octadecadienoic acid (Z,Z)-, methyl ester (CAS) Methyl linoleate $$ METHYL CIS-9,CIS-12-OCTADECADIENOATE $$ Methyl oc



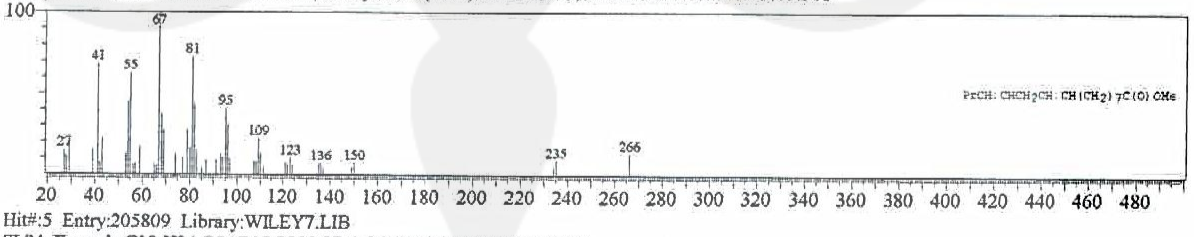
Hit#:2 Entry:205831 Library:WILEY7.LIB
SI:96 Formula:C19 H34 O2 CAS:2462-85-3 MolWeight:294 RetIndex:0
CompName:OCTADECA-9,12-DIENOIC ACID METHYL ESTER $$ 9,12-OCTADECADIENOIC ACID, METHYL ESTER $$



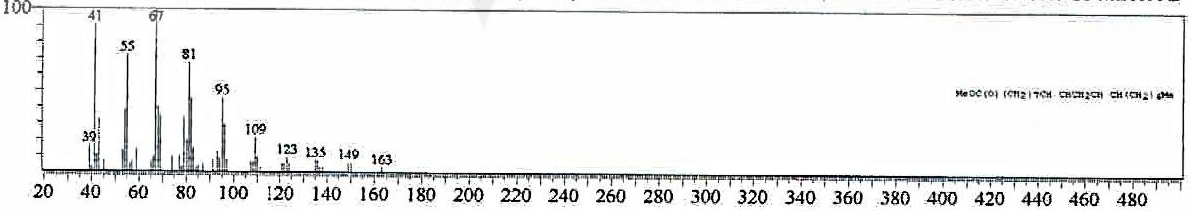
Hit#:3 Entry:205821 Library:WILEY7.LIB
SI:95 Formula:C19 H34 O2 CAS:112-63-0 MolWeight:294 RetIndex:0
CompName:9,12-Octadecadienoic acid (Z,Z)-, methyl ester (CAS) Methyl linoleate $$ METHYL CIS-9,CIS-12-OCTADECADIENOATE $$ Methyl oc



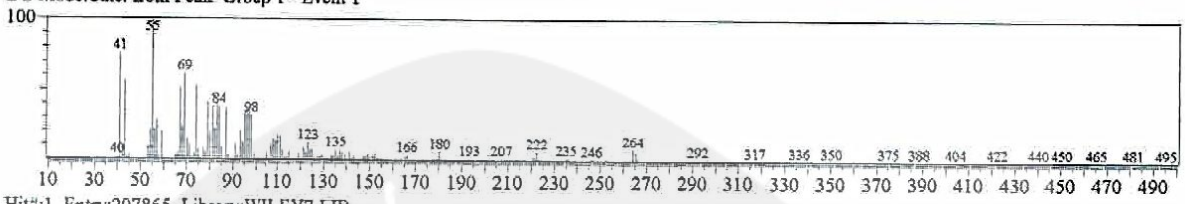
Hit#:4 Entry:175438 Library:WILEY7.LIB
SI:94 Formula:C17 H30 O2 CAS:2462-80-8 MolWeight:266 RetIndex:0
CompName:9,12-Hexadecadienoic acid, methyl ester (CAS) METHYL-9,12-HEXADECADIENOATE $$



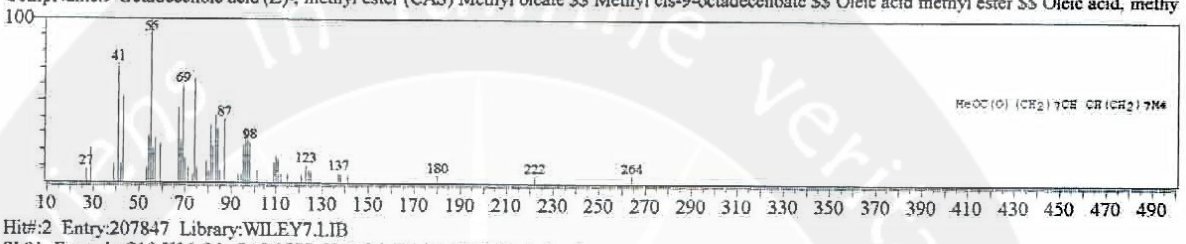
Hit#:5 Entry:205809 Library:WILEY7.LIB
SI:94 Formula:C19 H34 O2 CAS:2566-97-4 MolWeight:294 RetIndex:0
CompName:9,12-Octadecadienoic acid, methyl ester, (E,E)- (CAS) Methyl linolelaidate $$ METHYL T9, T12 OCTADECADIENOATE $$ METHYL



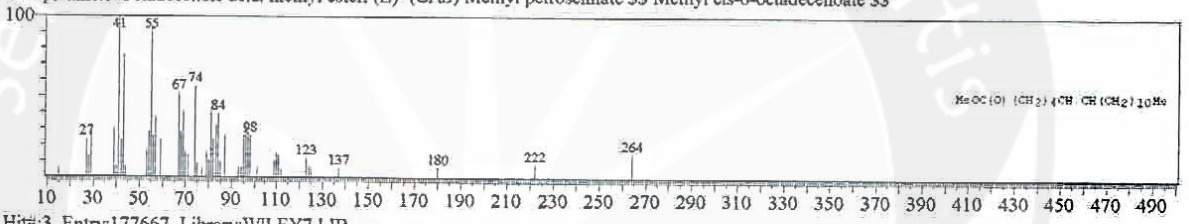
<< Target >>
Line#:9 R.Time:20.770(Scan#:5332) MassPeaks:345
RawMode:Averaged 20.767-20.773(5331-5333) BasePeak:55.00(104472)
BG Mode:Calc. from Peak Group 1 - Event 1



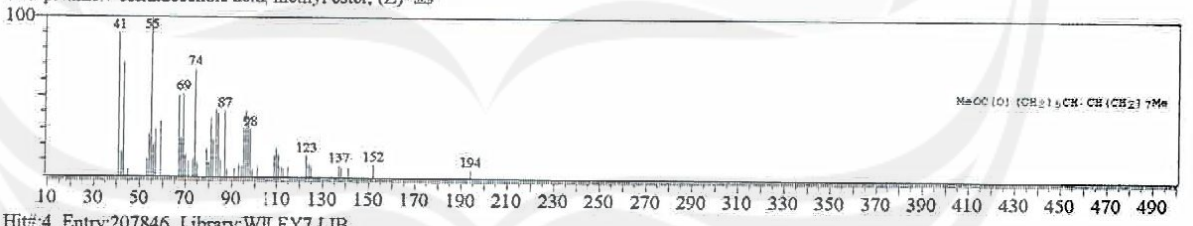
Hit#:1 Entry:207865 Library:WILEY7.LIB
SI:92 Formula:C19 H36 O2 CAS:112-62-9 MolWeight:296 RetIndex:0
CompName:9-Octadecenoic acid (Z)-, methyl ester (CAS) Methyl oleate $$ Methyl cis-9-octadecenoate $$ Oleic acid methyl ester $$ Oleic acid, methy



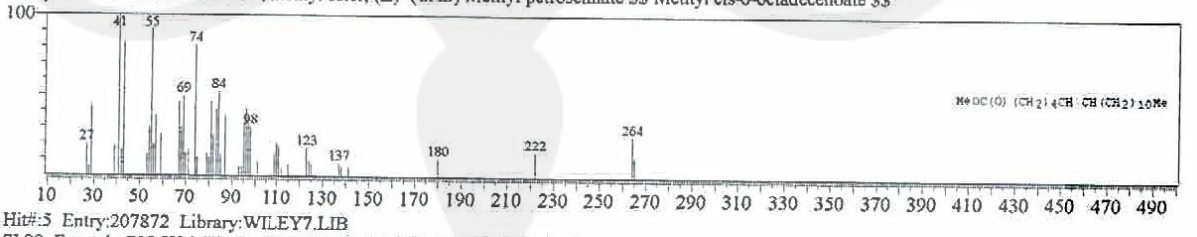
Hit#:2 Entry:207847 Library:WILEY7.LIB
SI:91 Formula:C19 H36 O2 CAS:2777-58-4 MolWeight:296 RetIndex:0
CompName:6-Octadecenoic acid, methyl ester, (Z)- (CAS) Methyl petroselinate $$ Methyl cis-6-octadecenoate $$



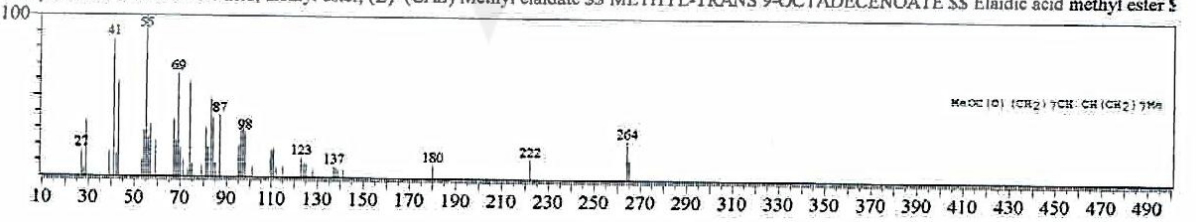
Hit#:3 Entry:177667 Library:WILEY7.LIB
SI:90 Formula:C17 H32 O2 CAS:56875-67-3 MolWeight:268 RetIndex:0
CompName:7-Hexadecenoic acid, methyl ester, (Z)- $$



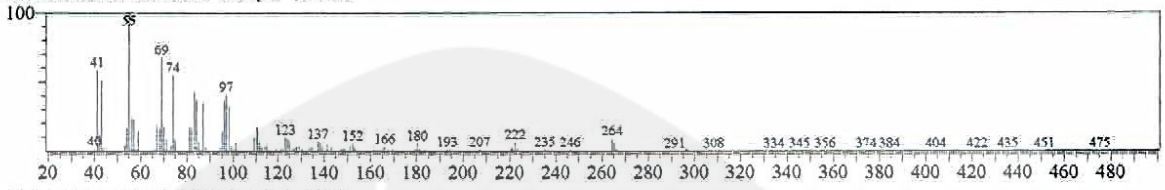
Hit#:4 Entry:207846 Library:WILEY7.LIB
SI:90 Formula:C19 H36 O2 CAS:2777-58-4 MolWeight:296 RetIndex:0
CompName:6-Octadecenoic acid, methyl ester, (Z)- (CAS) Methyl petroselinate $$ Methyl cis-6-octadecenoate $$



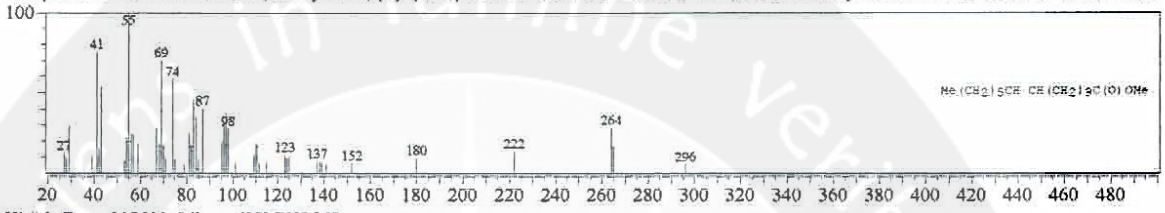
Hit#:5 Entry:207872 Library:WILEY7.LIB
SI:89 Formula:C19 H36 O2 CAS:1937-62-8 MolWeight:296 RetIndex:0
CompName:9-Octadecenoic acid, methyl ester, (E)- (CAS) Methyl elaidate $$ METHYL-TRANS 9-OCTADECENOATE $$ Elaidic acid methyl ester $



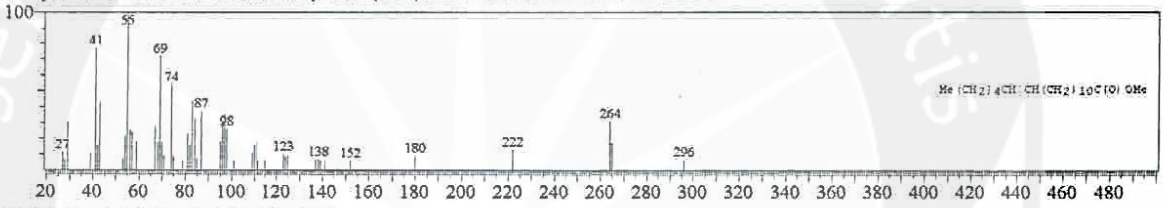
<< Target >>
Line#:10 R.Time:20.837(Scan#:5352) MassPeaks:301
RawMode:Averaged 20.833-20.840(5351-5353) BasePeak:55.00(46453)
BG Mode:Calc. from Peak Group 1 - Event 1



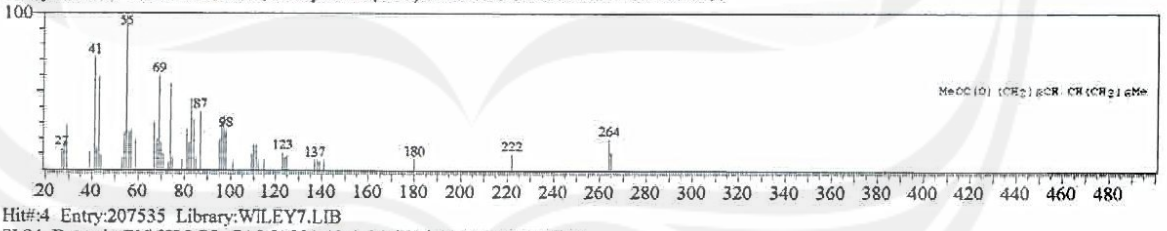
Hit#:1 Entry:207531 Library:WILEY7.LIB
SI:95 Formula:C19 H36 O2 CAS:1937-63-9 MolWeight:296 RetIndex:0
CompName:11-Octadecenoic acid, methyl ester, (Z)- (CAS) METHYL CIS OCTADEC-11-ENOATE $$ Methyl cis-octadec-11-enoate $$ cis-11-Octad



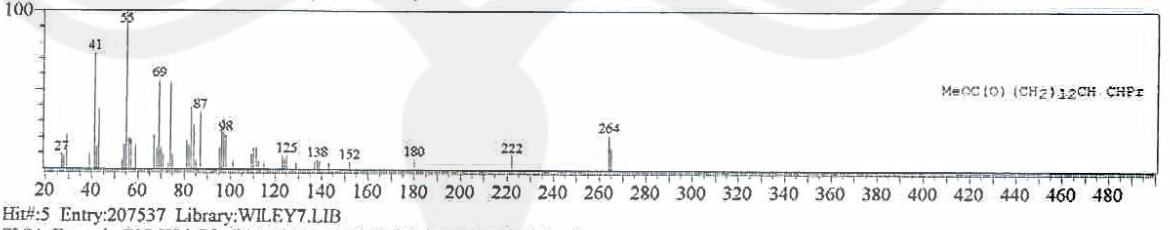
Hit#:2 Entry:207532 Library:WILEY7.LIB
SI:95 Formula:C19 H36 O2 CAS:56554-46-2 MolWeight:296 RetIndex:0
CompName:12-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-12-ENOATE $$



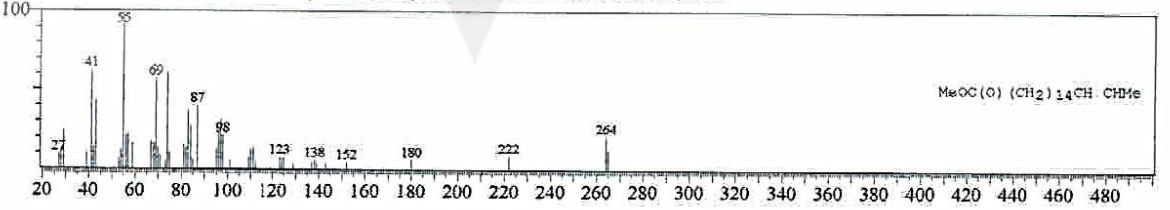
Hit#:3 Entry:207529 Library:WILEY7.LIB
SI:94 Formula:C19 H36 O2 CAS:13481-95-3 MolWeight:296 RetIndex:0
CompName:10-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-10-ENOATE $$



Hit#:4 Entry:207535 Library:WILEY7.LIB
SI:94 Formula:C19 H36 O2 CAS:56554-48-4 MolWeight:296 RetIndex:0
CompName:14-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-14-ENOATE $$



Hit#:5 Entry:207537 Library:WILEY7.LIB
SI:94 Formula:C19 H36 O2 CAS:56554-49-5 MolWeight:296 RetIndex:0
CompName:16-Octadecenoic acid, methyl ester (CAS) METHYL OCTADEC-16-ENOATE $$



3.4. Data mentah hasil GC-MS

Tabel 10. Data Mentah Hasil GC-MS

Asam Lemak	Ulangan 1	Ulangan 2	Ulangan 3	Rata-rata	Error
Asam Palmitat	56,65	55,84	55,04	55,8433	0,80500
Asam oktadekadienoat	16,52	17,36	16,71	16,8633	0,44049
Asam n-oktadesenoat	18,66	20,3	20	19,6533	0,87323
Lainnya	9,17	6,5	8,25	7,97333	1,35633

Lampiran 4. Perhitungan Derajat Ketidakjenuhan Minyak *Talinum paniculatum* (Giakoumis, 2013)

Tabel 11. Derajat Ketidakjenuhan Minyak *T. paniculatum*

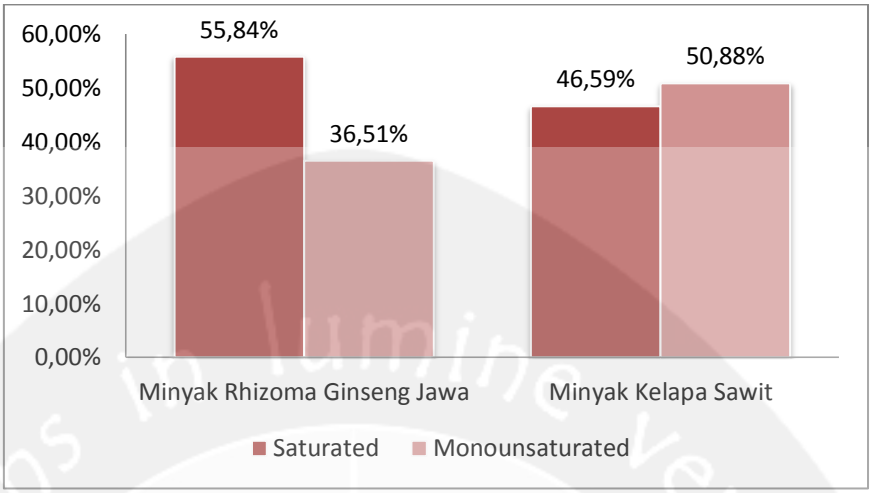
Asam Lemak	Persen Kadar (a)	Ik. Ganda	Nilai (b)	a x b
Asam Palmitat	55,84	0	0 %	0
Asam oktadekadienoat	16,86	2	2 %	0,3372
Asam n-oktadesenoat	19,65	1	1 %	0,1965
Lainnya	7,97			0
Jumlah/derajat ketidakjenuhan =				**0,5337**

Lampiran 5. Perbandingan Kandungan Asam Lemak pada Minyak Kelapa Sawit dan *Talinum paniculatum*

Tabel 12. Perbandingan Kandungan Asam Lemak Mayor pada Minyak Kelapa Sawit dan Rhizoma Ginseng Jawa

Jenis Minyak	Kadar pada Minyak Kelapa*	Kadar pada Minyak Ginseng Jawa
Asam lemak jenuh (*saturated*)		
Asam heksadekanoat (palmitat)	42,39 ± 2,81	55,84 ± 0,805
Asam oktadekanoat (stearat)	4,20 ± 0,86	
Asam lemak tak jenuh tunggal (*monounsaturated*)		
Asam n-oktadesenoat (oleat/elaidat/petroselinat)	40,91 ± 2,97	19,65 ± 0,873
Asam oktadekadienoat (linoleat)	9,97 ± 1,54	16,86 ± 0,440

Catatan: Nilai kadar asam lemak pada minyak kelapa diperoleh dari literatur Giakoumis, 2013.



Gambar 13. Diagram Kandungan Asam Lemak Mayor pada Minyak Kelapa Sawit dan Rhizoma Ginseng Jawa

Tabel 13. Sifat Metil Ester Minyak Kelapa Sawit

Cetane number	**Density (kg/m3)**	**LHV (kJ/kg)**	**HHV (kJ/kg)**	**Viscosity (mm2/s)**	**Flash point (°C)**	**Pour point (°C)**
61.2 (4.90)	874.7 (4.01)	37,080 (855)	39,985 (688)	4.61 (0.61)	161.9 (17.3)	11.8 (2.4)
Cloud point (°C)	**CFP point (°C)**	**Iodine number**	**Oxidation stability (h)**	**Acid number (mg KOH/g)**	**Sulfur content (ppm)**	
13.3 (2.3)	11.4 (4.7)	52.7 (5.6)	11.4 (2.38)	0.27 (0.11)	3.1 (2.7)	
Distillation temp. 50% vol. (°C)	**Distillation temp. 90% vol. (°C)**	**C (% w/w)**	**H (% w/w)**	**O (% w/w)**	**Molecular weight (kg/kmol)**	
327.7 (4.0)	339.3 (6.7)	76.09 (0.37)	12.44 (0.50)	11.27 (0.43)	284.12 (0.14)	

Catatan: Hasil analisis statistik oleh Giakoumis (2013) dari beberapa studi, nilai dalam kurung merupakan standar deviasi dari beberapa data sifat minyak kelapa sawit yang digunakan dalam studinya.

Lampiran 6. Perhitungan Tingkat Konversi Minyak *Talinum paniculatum* menjadi Biodiesel

Rumus untuk menghitung tingkat konversi minyak *T. paniculatum* menjadi biodiesel (%Konversi):

$$\%\text{Konversi} = \frac{Wbiodiesel}{Wminyak} \times 100\%$$
$$= \frac{-}{9{,}8} \times 100\%$$
$$= -$$

Lampiran 7. Kandungan Asam Lemak pada Berbagai Minyak dan Sifat-Sifat Biodiesel yang Dihasilkannya (Giakoumis, 2013)

Tabel 14. Kandungan Asam Lemak Berbagai Minyak

Jenis Asam Lemak	Jenis Minyak (%)				
	Kelapa	Kelapa Sawit	Jathropa	Kanola	Kacang Kedelai
Asam Kaprilat (8:0)	6,46	0,08	-	-	-
Asam Kaprat (10:0)	5,62	0,06	-	-	-
Asam Laurat (12:0)	49,91	0,38	-	-	0,08
Asam Myristat (14:0)	18,74	1,13	0,15	-	0,12
Asam Palmitat (16:0)	9,69	42,39	14,42	4,51	11,44
Asam Palmitoleat (16:1)	0,11	0,17	0,69	0,36	0,16
Asam Margarat (17:0)	-	0,06	0,08	0,14	-
Asam Stearat (18:0)	2,83	4,20	5,82	2,00	4,14
Asam Oleat (18:1)	6,83	40,91	42,81	60,33	23,47
Asam Arasidat (20:0)	-	-	-	-	-
Asam Linoleat (18:2)	2,21	9,97	35,38	21,24	53,46
Asam Linolenat (18:3)	-	0,29	0,23	9,49	6,64
Asam Arasidat (20:0)	0,10	0,29	0,09	0,62	0,33
Asam Gondoat (20:1)	-	0,16	0,10	1,49	0,22
Asam Behenat (20:0)	-	-	0,14	0,35	0,27
Asam Erusat (22:1)	-	-	-	0,42	0,07
Asam Lignoserat (24:0)	-	0,05	1,47	0,16	0,13

Catatan:

- Data dari beberapa literatur yang dikaji dalam studi Giakoumis (2013)
- (-) Data tidak tersedia

Tabel 15. Derajat ketidakjenuhan dan angka iodin berbagai minyak

Jenis Minyak	Derajat Ketidakjenuhan	Angka Iodin
Kelapa	0,12	7,8
Kelapa Sawit	0,51	53,1
Jathropa	0,62	99
Kanola	1,33	104
Kacang Kedelai	1,51	126,2

Tabel 16. Sifat-sifat Biodiesel yang dihasilkan dari berbagai minyak

Jenis Asam Lemak	Jenis Minyak (%)				
	Kelapa	**Kelapa Sawit**	**Jathropa**	**Kanola**	**Kacang Kedelai**
Angka Setana	61	61,2	55,7	54,8	51,8
Densitas (kg/mm^3)	870,8	874,7	878,7	881,6	882,8
Nilai Pemanasan Rendah (kJ/kg)	35,985	37,080	38,050	37,980	37,750
Nilai Pemanasan Tinggi (kJ/kg)	38,985	39,985	40,380	39,975	40,020
Viskositas (mm/s)	2,78	4,61	4,72	4,40	4,29
Titik Nyala (^oC)	127,7	161,9	158,5	159,0	158,8
Titik Lebur (^oC)	-3,8	11,8	-0,9	-8,0	-3,0
Titik Embun (^oC)	-1,2	13,3	5,7	-1,8	0,1
Angka Iodin	7,8	52,7	99,0	104	126
Stabilitas Oksidasi (jam)	11	11,4	5,0	11	5
Angka Asam (mg KOH/g)	0,16	0,27	0,34	0,22	0,32
Kandungan S (ppm)	3,3	3,1	12,9	2,2	2,7
C (%w/w)	72,75	76,09	76,57	-	77,03
H (%w/w)	11,65	12,44	12,21	12,84	11,90
O (%w/w)	-	11,27	11,32	11,04	10,95

Catatan:

- Data dari beberapa literatur yang dikaji dalam studi Giakoumis (2013)
- (-) Data tidak tersedia