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APPENDIX I

Table 7.1 The lapsing times (seconds) of the second bee revisited on the same flower (*Mimosa invisa*) after the first visit of honeybee foragers.

Number of foragers	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
1	17	22	30	25	420
2	16	23	35	22	480
3	15	23	31	27	660
4	17	25	28	27	540
5	18	22	34	24	720
6	16	24	32	26	780
7	17	23	29	24	480
8	15	23	27	27	420
9	18	22	29	25	420
10	16	24	31	27	600
X ±SD	16.5±1.1	23.1±0.9	30.6±2.5	25.4±1.8	600±162.5

Table 7.2 Gland width of mandibular glands of honeybee foragers in Thailand

Species	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
Data	width	width	width	width	width
1	240	360	533	142	540
2	220	480	590	180	510
3	210	450	520	180	468
4	228	430	538	197	518
5	236	422	545	208	506
6	224	387	531	176	531
7	237	392	582	184	527
8	225	460	559	192	509
9	213	418	561	169	514
10	219	429	577	196	517
Average	225.2	422.8	553.6	182.4	514
SD	10.16	36.03	23.90	18.29	19.37

Table 7.3 Gland length of mandibular glands of honeybee foragers in Thailand

Species	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
Data	length	length	length	length	length
1	355	510	616	213	620
2	360	520	660	200	660
3	348	500	680	220	570
4	338	508	624	217	589
5	332	514	633	228	591
6	340	511	629	203	629
7	329	518	637	213	632
8	335	515	654	224	601
9	344	509	647	234	593
10	330	516	665	220	587
Average	341.1	512.1	644.5	217.2	607.2
SD	10.57	5.80	20.21	10.50	27.21

Table 7.4 Cell type I width of mandibular glands of honeybee foragers in Thailand

Species	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
	width	width	width	width	width
1	3.2	4	4.7	3.2	4.7
2	2.4	4.2	4.6	2.7	4.4
3	2.7	4.3	4.8	2.8	4.5
4	2.9	4.2	4.5	2.6	4.3
5	2.2	4.3	5.2	2.7	4.5
6	2.5	4.5	5.3	2.8	4.8
7	2.4	4.2	5.2	2.3	4.4
8	2.6	4.2	5.1	2.5	4.3
9	2.3	4.4	5.2	2.9	4.7
10	2.2	4.3	5.1	3.1	4.6
Average	2.54	4.26	4.97	2.76	4.52
SD	0.32	0.13	0.29	0.26	0.17

Table 7.5 Cell type I length of mandibular glands of honeybee foragers in Thailand

Species	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
Data	length	length	length	length	length
1	3.6	4.4	6.2	3.5	5.1
2	3.7	4.9	5.7	3.4	5.3
3	3.1	4.8	5.6	3.9	5.4
4	3.2	4.7	5.2	3.9	5.2
5	3.1	4.6	6.2	3.4	5.3
6	3.3	4.6	6.3	3.6	4.9
7	3.2	4.7	6.1	3.8	5.1
8	3.4	4.4	5.9	3.7	4.8
9	3.4	4.3	6.4	3.3	5.5
10	3.3	4.2	6	3.8	5.2
Average	3.33	4.56	5.96	3.63	5.18
SD	0.20	0.22	0.36	0.22	0.21

Table 7.6 Cell width of type II cells of honeybee foragers in Thailand

Number	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
	width	width	width	width	width
1	14	16.6	21.6	15.5	17.5
2	13.8	16.9	20.8	14.1	16.2
3	13.5	16.8	21.1	14.2	17.8
4	14.4	17.4	22.2	14.7	18.4
5	13.9	17.8	22.5	13.6	16.5
6	14.1	15.7	22.7	13.8	17.6
7	13.6	15.5	21.4	14	18.2
8	13.7	17.4	20.1	14.1	17.9
9	14.3	16.3	20.5	14.4	17.4
10	14.2	16.2	21.2	13.5	18.3
Average	13.95	16.66	21.59	14.19	17.58
SD	0.30	0.75	0.85	0.58	0.73

Table 7.7 Cell length of type II cells of honeybee foragers in Thailand

Number	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
	length	length	length	length	length
1	16.2	18.7	22.8	18.8	20.3
2	17.1	18.3	23.1	18.4	20.0
3	16.6	18.6	23.5	18.7	19.7
4	16.8	18.9	24	19.2	21.1
5	17.9	18.8	23.2	19.5	19.4
6	17	19.7	22.6	18.1	20.2
7	17.1	18.4	21.9	17.1	19.3
8	17.2	18.1	21.2	17.7	18.9
9	17.3	19.2	20.7	16.8	19.6
10	16.7	18.6	21.2	17.5	19.5
Average	16.99	18.73	22.42	18.18	19.8
SD	0.45	0.46	1.11	0.89	0.62

Table 7.8 Cell width of type III cells of honeybee foragers in Thailand

Number	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
	width	width	width	width	width
1	13.3	16.3	20.3	14.9	16.8
2	13.7	16.1	21	14.6	16
3	13.5	17.4	20.4	14	15.9
4	13.9	17	21.6	14.8	16.2
5	12.1	16.5	21.3	13.9	16.5
6	12.6	16.2	21.7	13.7	17.6
7	11.9	15.3	21.9	13.6	17.3
8	12.5	17.1	20.4	14.8	16.7
9	13.8	16.3	20.1	13.9	16.9
10	12	16.5	21.2	13.8	17.5
Average	12.93	16.47	21.59	14.2	16.74
SD	0.79	0.59	0.65	0.51	0.60

Table 7.9 Cell length of type III cells of honeybee foragers in Thailand

Number	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
	length	length	length	length	length
1	15.8	17.7	21.1	17.5	18.8
2	16.5	17.5	22.5	17.6	18.5
3	15.9	18.3	22.7	17.8	18.3
4	16.5	18.1	22.5	18.7	19
5	17.6	18.4	21.6	19.3	18.9
6	17.5	17.9	22	18.6	18.1
7	17.3	17.6	21.9	17.9	19.2
8	16.8	18.1	21.5	17.5	18.7
9	17	19.2	20.1	17.1	19.4
10	17.9	17.6	20.1	17.3	19
Average	16.88	18.04	21.6	17.93	18.79
SD	0.71	0.51	0.93	0.70	0.40

Table 7.10 Comparative cell width among mandibular gland of foragers in Thailand

Number	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
Cell type	Width	Width	Width	Width	Width
Type I	2.54±0.32	4.26±0.13	4.97±0.29	2.76±0.27	4.52±0.18
Type II	13.95±0.30	16.66±0.75	21.59±0.85	14.19±0.58	17.58±0.73
Type III	16.88±0.71	18.04±0.51	21.60±0.93	17.93±0.71	18.79±0.40

Table 7.11 Comparative cell length among mandibular gland of foragers in Thailand

Number	<i>A. andreniformis</i>	<i>A. cerana</i>	<i>A. dorsata</i>	<i>A. florea</i>	<i>A. mellifera</i>
Cell type	length	length	length	length	length
Type I	3.33±0.20	4.56±0.22	5.96±0.37	3.63±0.22	5.18±0.21
Type II	16.99±0.46	18.73±0.46	22.42±1.11	18.18±0.89	19.80±0.62
Type III	16.88±0.71	18.04±0.51	21.60±0.93	17.93±0.71	18.79±0.40

One way

Descriptives

	N	Mean	Std. Deviation	Std. Error
Lapsing time <i>A. andreniformis</i>	10	16.5000	1.0801	0.3416
<i>A. cerana</i>	10	13.1000	0.9944	0.3145
<i>A. dorsata</i>	10	30.6000	2.5473	0.8055
<i>A. florea</i>	10	25.4000	1.7127	0.5416
<i>A. mellifera</i>	10	552.0000	132.0606	41.7612
Total	50	129.5200	220.8151	31.2280
Gland width <i>A. andreniformis</i>	10	182.4000	10.1631	3.2139
<i>A. cerana</i>	10	422.8000	36.0302	11.3938
<i>A. dorsata</i>	10	553.6000	23.9082	7.5604
<i>A. florea</i>	10	225.2000	18.2951	5.8754
<i>A. mellifera</i>	10	514.0000	19.3793	6.1283
Total	50	379.6000	153.4287	21.6981
Gland length <i>A. andreniformis</i>	10	217.2000	10.5071	3.3226
<i>A. cerana</i>	10	512.0000	5.8013	1.8345
<i>A. dorsata</i>	10	644.5000	20.2169	6.3931
<i>A. florea</i>	10	341.1000	10.5772	3.3448
<i>A. mellifera</i>	10	607.2000	27.2185	8.6072
Total	50	464.4200	164.5518	23.2711
Cell type I width <i>A. andreniformis</i>	10	2.5400	.3204	.1013
<i>A. cerana</i>	10	4.2600	.1350	4.269E-02
<i>A. dorsata</i>	10	4.9700	.2908	9.195E-02
<i>A. florea</i>	10	2.7600	.2675	8.459E-02
<i>A. mellifera</i>	10	4.5200	.1751	5.538E-02
Total	50	3.8100	1.0146	.1435
Cell type I length <i>A. andreniformis</i>	10	3.3300	.2003	6.333E-02
<i>A. cerana</i>	10	4.5600	.2271	7.180E-02
<i>A. dorsata</i>	10	5.9600	.3688	.1166
<i>A. florea</i>	10	3.6300	.2214	7.00E-02
<i>A. mellifera</i>	10	5.1800	.2150	6.779E-02
Total	50	4.5320	1.0110	.1430

One way

Descriptives

	N	Mean	Std. Deviation	Std. Error	
Cell type II width	<i>A. andreniformis</i>	10	13.9500	.3028	9.574E-02
	<i>A. cerana</i>	10	16.6600	.7516	.2377
	<i>A. dorsata</i>	10	21.4100	.8543	.2702
	<i>A. florea</i>	10	14.1900	.5820	.1841
	<i>A. mellifera</i>	10	17.5800	.7330	.2318
	Total	50	16.7580	2.8155	.3982
Cell type II length	<i>A. andreniformis</i>	10	16.9900	.4581	.1449
	<i>A. cerana</i>	10	18.7300	.4620	.1461
	<i>A. dorsata</i>	10	22.4200	1.1114	.3514
	<i>A. florea</i>	10	18.1800	.8979	.2839
	<i>A. mellifera</i>	10	19.8000	.6236	.1972
	Total	50	19.2240	1.9918	.2817
Cell type III width	<i>A. andreniformis</i>	10	16.8800	.7115	.2250
	<i>A. cerana</i>	10	18.0400	.5125	.1621
	<i>A. dorsata</i>	10	21.6000	.9333	.2951
	<i>A. florea</i>	10	17.9300	.7072	.2236
	<i>A. mellifera</i>	10	18.7900	.4012	.1269
	Total	50	18.6480	1.7389	.2459
Cell type III length	<i>A. andreniformis</i>	10	12.9300	.7931	.2508
	<i>A. cerana</i>	10	16.4700	.5945	.1880
	<i>A. dorsata</i>	10	20.9900	.6506	.2057
	<i>A. florea</i>	10	14.2000	.5121	.1619
	<i>A. mellifera</i>	10	16.7400	.6022	.1904
	Total	50	16.2660	2.8502	.4031

Descriptives

95% Confidence Interval for Mean

	Lower Bound	Upper Bound	Minimum	Minimum
Lapsing time <i>A. andreniformis</i>	15.7273	17.2727	15.00	18.00
<i>A. cerana</i>	22.3886	23.8114	22.00	25.00
<i>A. dorsata</i>	28.8778	32.4222	27.00	35.00
<i>A. florea</i>	24.1748	26.6252	22.00	27.00
<i>A. mellifera</i>	457.5295	646.4705	420.00	780.00
Total	66.7650	192.2750	15.00	780.00
Gland width <i>A. andreniformis</i>	169.3125	195.4875	142.00	208.00
<i>A. cerana</i>	397.3255	448.5745	360.00	480.00
<i>A. dorsata</i>	536.4971	570.7029	520.00	590.00
<i>A. florea</i>	217.9297	232.4703	210.00	240.00
<i>A. mellifera</i>	500.1369	527.8631	468.00	540.00
Total	335.9960	423.2040	142.00	590.00
Gland length <i>A. andreniformis</i>	209.6836	224.7166	200.00	234.00
<i>A. cerana</i>	507.9500	516.2500	500.00	520.00
<i>A. dorsata</i>	630.0377	658.9623	616.00	680.00
<i>A. florea</i>	333.5335	348.6665	329.00	360.00
<i>A. mellifera</i>	587.7291	626.6709	570.00	660.00
Total	417.6549	511.1851	200.00	680.00
Cell type I width <i>A. andreniformis</i>	2.3108	2.7629	2.20	3.20
<i>A. cerana</i>	4.1634	4.3566	4.00	4.20
<i>A. dorsata</i>	4.7642	5.1780	4.50	5.30
<i>A. florea</i>	2.5685	2.9514	2.30	3.20
<i>B. mellifera</i>	4.3947	4.6453	4.30	4.80
Total	3.5216	4.0984	2.20	5.30
Cell type I length <i>A. andreniformis</i>	3.1867	3.4733	3.10	3.70
<i>A. cerana</i>	4.3976	4.7224	4.20	4.90
<i>A. dorsata</i>	5.6962	6.2238	5.20	6.40
<i>A. florea</i>	3.4716	3.7844	3.30	3.90
<i>B. mellifera</i>	5.0262	5.3338	4.80	5.50
Total	4.2447	4.8193	3.10	6.40

Descriptives

95% Confidence Interval for Mean

		Lower Bound	Upper Bound	Minimum	Manimum
Cell type II width	<i>A. andreniformis</i>	13.7334	14.1666	13.50	14.40
	<i>A. cerana</i>	16.1223	17.1977	15.50	17.80
	<i>A. dorsata</i>	20.7988	22.0212	20.10	22.70
	<i>A. florea</i>	13.7736	14.6064	13.50	15.50
	<i>A. mellifera</i>	17.0556	18.1044	16.20	18.40
	Total	15.9578	17.5582	13.50	22.70
Cell type II length	<i>A. andreniformis</i>	16.6623	17.3177	16.20	17.90
	<i>A. cerana</i>	18.3995	19.0605	18.10	19.70
	<i>A. dorsata</i>	21.6250	23.2150	20.70	24.00
	<i>A. florea</i>	17.5377	18.8223	16.80	19.50
	<i>A. mellifera</i>	19.3539	20.2461	18.90	21.10
	Total	18.6579	19.7901	16.20	24.00
Cell type III width	<i>A. andreniformis</i>	16.3710	17.3890	15.80	17.90
	<i>A. cerana</i>	16.6734	18.4066	17.50	19.20
	<i>A. dorsata</i>	20.9323	22.2677	20.10	22.70
	<i>A. florea</i>	13.7736	18.4359	17.10	19.30
	<i>A. mellifera</i>	18.5053	19.0770	18.10	19.40
	Total	18.1538	19.1422	15.80	22.70
Cell type III length	<i>A. andreniformis</i>	12.3627	13.4973	11.90	13.90
	<i>A. cerana</i>	16.0447	16.8953	15.30	17.40
	<i>A. dorsata</i>	20.5246	21.4554	20.10	21.90
	<i>A. florea</i>	13.8337	14.5663	13.60	14.90
	<i>A. mellifera</i>	16.3092	17.1708	15.90	17.60
	Total	15.4506	17.0760	11.90	21.90

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
Lapsing times	30.573	4	45	.000
Gland width	2.826	4	45	.036
Gland length	7.442	4	45	.000
Cell type I width	2.564	4	45	.051
Cell type I length	1.480	4	45	.224
Cell type II width	1.806	4	45	.144
Cell type II length	4.595	4	45	.003
Cell type III width	1.442	4	45	.236
Cell type III length	1.841	4	45	.138

Anova

		Sum of squares	df	Mean square	F	Sig.
Lapsing times	Between Groups	2232142.3	4	558035.57	159.881	.00
	Within Groups	157064.20	45	3490.316		
	Total	2389206.5	49			
Gland width	Between Groups	1129328.0	4	282332.00	526.084	.00
	Within Groups	24150.000	45	536.667		
	Total	1153478.2	49			
Gland length	Between Groups	1314138.7	4	328534.67	1168.747	.00
	Within Groups	12649.500	45	281.100		
	Total	1326788.2	49			
Cell type I width	Between Groups	47.676	4	11.919	193.700	.00
	Within Groups	2.769	45	6.153E-02		
	Total	50.445	49			
Cell type I length	Between Groups	47.183	4	11.796	182.659	.00
	Within Groups	2.906	45	6.458E-02		
	Total	50.089	49			
Cell type II width	Between Groups	368.059	4	92.015	203.342	.00
	Within Groups	20.363	45	.453		
	Total	388.422	49			
Cell type II length	Between Groups	168.709	4	42.177	73.903	.00
	Within Groups	25.682	45	.571		
	Total	194.391	49			
Cell type III width	Between Groups	379.797	4	94.949	233.801	.00
	Within Groups	18.275	45	.406		
	Total	398.072	49			
Cell type III length	Between Groups	127.455	4	31.864	69.235	.00
	Within Groups	20.710	45	.460		
	Total	148.615	49			

Post Hoc Tests

Homogeneous Subsets

Lapsing times

Duncan: Uses harmonic Mean sample size = 10.00

Subset for alpha= 0.05			
Species	N	1	2
<i>A. andreniformis</i>	10	16.500	
<i>A. cerana</i>	10	23.100	
<i>A. dorsata</i>	10	25.400	
<i>A. florea</i>	10	30.600	
<i>A. mellifera</i>	10		552.00
Sig.		.633	1.00

Means for groups in homogeneous subsets are displayed.

Gland width

Duncan: Uses harmonic Mean sample size = 10.00

Subset for alpha = 0.05						
Species	N	1	2	3	4	5
<i>A. andreniformis</i>	10	182.400				
<i>A. florea</i>	10		225.200			
<i>A. cerana</i>	10			422.800		
<i>A. mellifera</i>	10				514.00	
<i>A. dorsata</i>	10					553.600
Sig.		1.00	1.00	1.00	1.00	1.00

Means for groups in homogeneous subsets are displayed.

Gland length

Duncan: Uses harmonic Mean sample size = 10.00

Subset for alpha = 0.05						
Species	N	1	2	3	4	5
<i>A. andreniformis</i>	10	217.200				
<i>A. florea</i>	10		341.100			
<i>A. cerana</i>	10			512.100		
<i>A. mellifera</i>	10				607.200	
<i>A. dorsata</i>	10					644.500
Sig.		1.00	1.00	1.00	1.00	1.00

Means for groups in homogeneous subsets are displayed.

Cell type I width

Duncan: Uses harmonic Mean sample size = 10.00

Subset for alpha = 0.05

Species	N	1	2	3	4
<i>A. andreniformis</i>	10	2.5400			
<i>A. florea</i>	10	2.7600			
<i>A. cerana</i>	10		4.2600		
<i>A. mellifera</i>	10			4.5200	
<i>A. dorasata</i>	10				4.9700
Sig.		.053	1.00	1.00	1.00

Means for groups in homogeneous subsets are displayed.

Cell type I length

Duncan: Uses harmonic Mean sample size = 10.00

Subset for alpha = 0.05

Species	N	1	2	3	4	5
<i>A. andreniformis</i>	10	3.3300				
<i>A. florea</i>	10		3.6300			
<i>A. cerana</i>	10			4.5600		
<i>A. mellifera</i>	10				5.1800	
<i>A. dorasata</i>	10					5.9600
Sig.		1.00	1.00	1.00	1.00	1.00

Means for groups in homogeneous subsets are displayed.

Cell type II width

Duncan: Uses harmonic Mean sample size = 10.00

Subset for alpha = 0.05

Species	N	1	2	3	4
<i>A. andreniformis</i>	10	13.9500			
<i>A. florea</i>	10	14.1900			
<i>A. cerana</i>	10		16.6600		
<i>A. mellifera</i>	10			17.5800	
<i>A. dorasata</i>	10				21.4100
Sig.		.429	1.00	1.00	1.00

Means for groups in homogeneous subsets are displayed

Cell type II length

Duncan: Uses harmonic Mean sample size = 10.00

Subset for alpha = 0.05

Species	N	1	2	3	4
<i>A. andreniformis</i>	10	16.9900			
<i>A. florea</i>	10		18.1800		
<i>A. cerana</i>	10		18.7300		
<i>A. mellifera</i>	10			19.800	
<i>A. dorasata</i>	10				22.4200
Sig.		1.00	.111	1.00	1.00

Means for groups in homogeneous subsets are displayed

Cell type III width

Duncan: Uses harmonic Mean sample size = 10.00

Subset for alpha = 0.05

Species	N	1	2	3	4
<i>A. andreniformis</i>	10	12.9300			
<i>A. florea</i>	10		14.200		
<i>A. cerana</i>	10			16.4700	
<i>A. mellifera</i>	10			16.7400	
<i>A. dorasata</i>	10				20.9900
Sig.		1.00	1.00	.349	1.00

Means for groups in homogeneous subsets are displayed

Cell type III length

Duncan: Uses harmonic Mean sample size = 10.00

Subset for alpha = 0.05

Species	N	1	2	3	4
<i>A. andreniformis</i>	10	16.8800			
<i>A. florea</i>	10		17.9300		
<i>A. cerana</i>	10		18.0400		
<i>A. mellifera</i>	10			18.7900	
<i>A. dorasata</i>	10				21.6000
Sig.		1.00	.719	1.00	1.00

Means for groups in homogeneous subsets are displayed

APPENDIX II

Preparation of electron microscopy solutions

1. 2% osmium solution

Osmium tetroxide	1.00 gm.
Fixing buffer	50.00 ml.

2. Karnovsky fixative

Paraformaldehyde	2.00 gm.
Distilled water	25.00 ml.
Glutaraldehyde	10.00 ml.
Fixing buffer	15.00 ml.

3. Fixing buffer 0.27 M.

Standard solution A	25.00 ml.
Distilled water	72.00 ml.

Adjust pH to 7.4 with a few drop of HCL 0.1 N.

4. Standard solution A

Na-Cacodylate	5.71 gm.
Distilled water	100.00 ml.

5. 0.1 N Hydrochloric acid (0.1 N HCL)

Concentrated hydrochloric acid	8.00 ml.
Distilled water	1000.00 ml.

6. Standard solution B

Na-Cacodylate	2.14 gm.
Distilled water	100.00 ml.

7. Washing buffer 0.1 M.

Standard solution B	25.00 ml.
Distilled water	73.00 ml.

Adjust the pH to 7.4 with a few drops of 0.1 N HCL solution.

8. 0.5% Uranyl acetate solution

Uranyl acetate	0.50 gm.
Distilled water	100.00 ml.

9. 1% Phosphotungstic acid solution

Phosphotungstic acid	1.00 gm.
Distilled water	100.00 ml.

10. Lead citrate solution

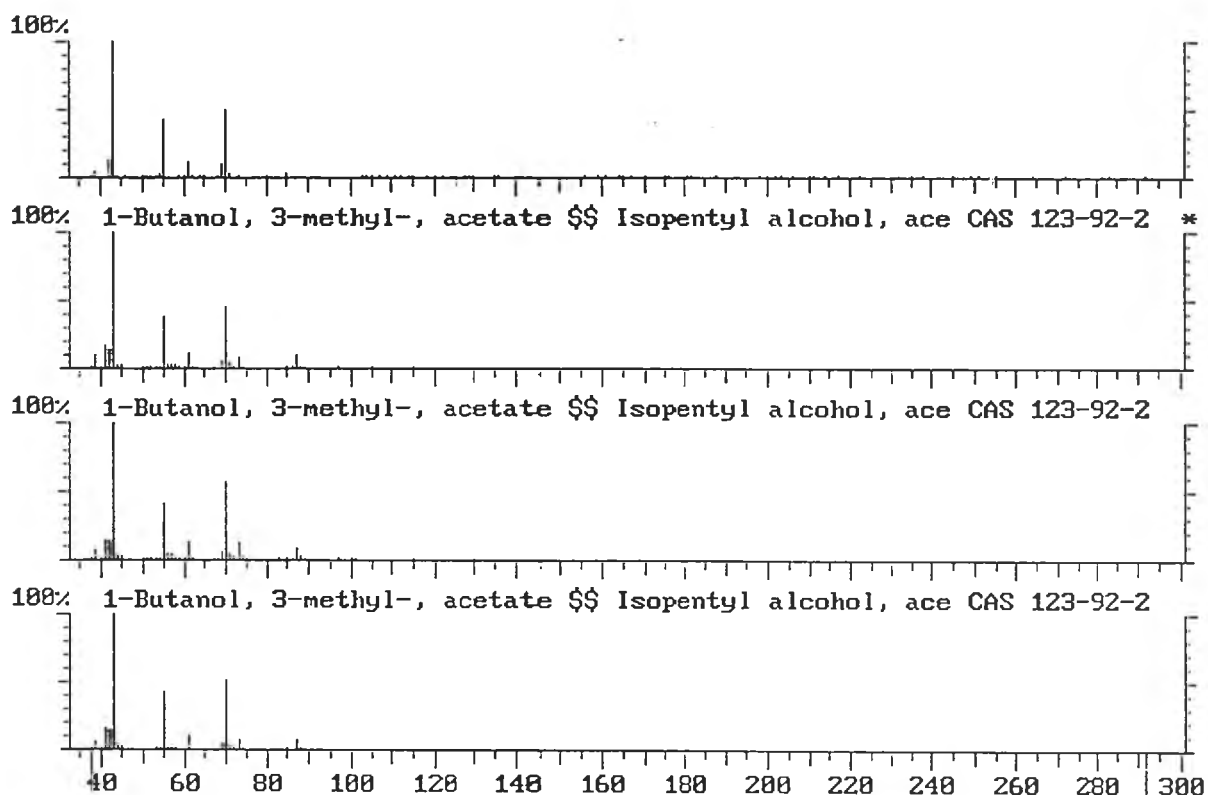
Lead nitrate	1.33 gm.
Sodium citrate	1.76 gm.
Distilled water	50.00 ml.
Sodium hydroxide (1N)	8.00 ml.

11.	<u>Epon-812 stock solution</u>	
	Mixture A: Epon-812	62.00 ml.
	DDSA (Dodecenyl succinic anhydride)	100.00 ml.
	Mixture B: Epon-812	100.00 ml.
	MNA (Nadic methyl anhydride)	89.00 ml.
12.	<u>Epon-812 working solutions</u>	
	Mixture A	80.00 ml.
	Mixture B	10.00 ml.
	DMP-30 (2,4,6 tridimethyl aminomethyl phenol)	1.50 ml.

APPENDIX III

Standard library of mass spectrum

Library search 1:

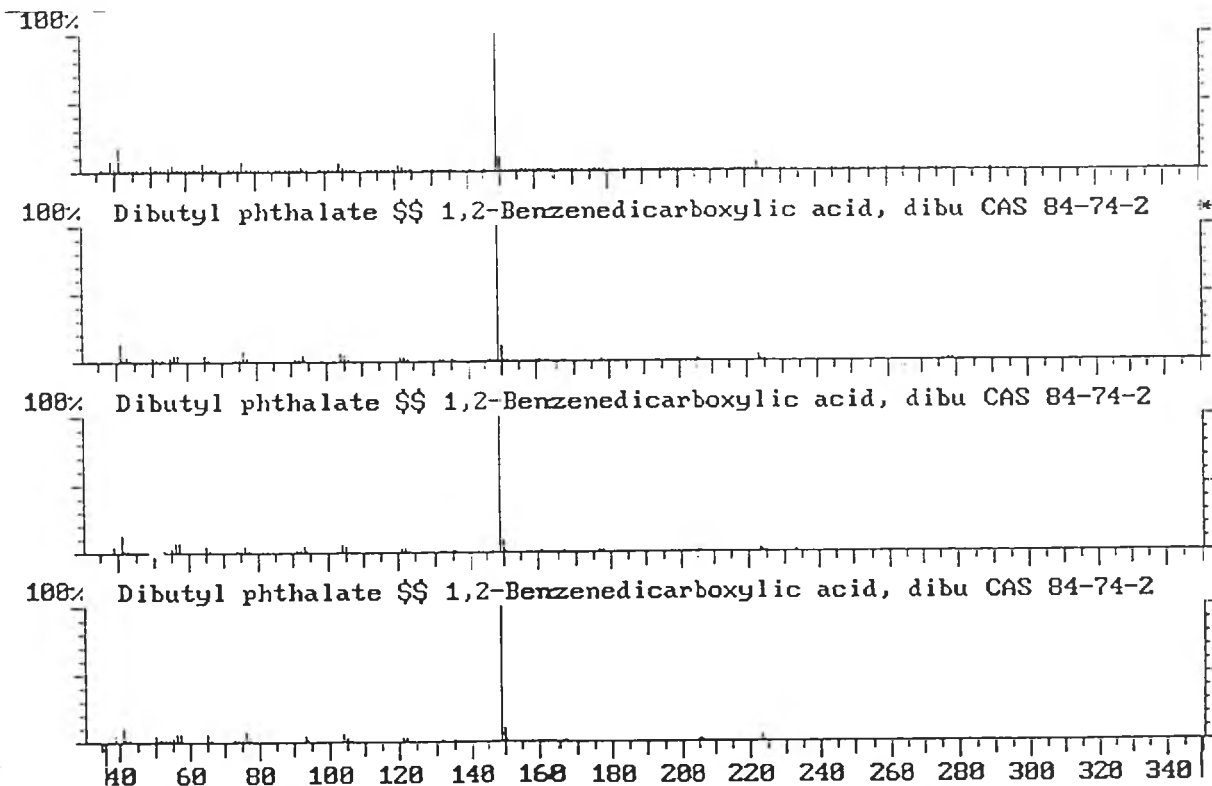


Formula C7.H14.O2

Rank 1 Index 109827

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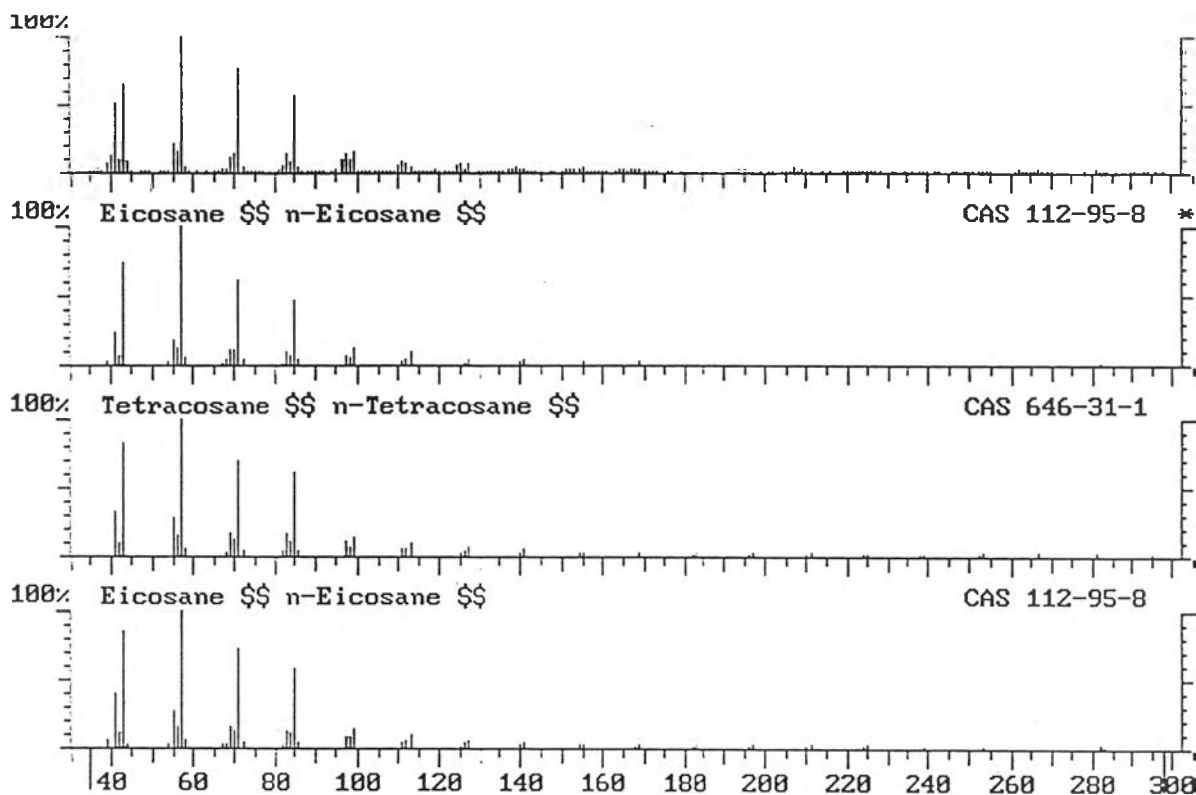


Formula C16.H22.O4

Rank 1 Index 123485

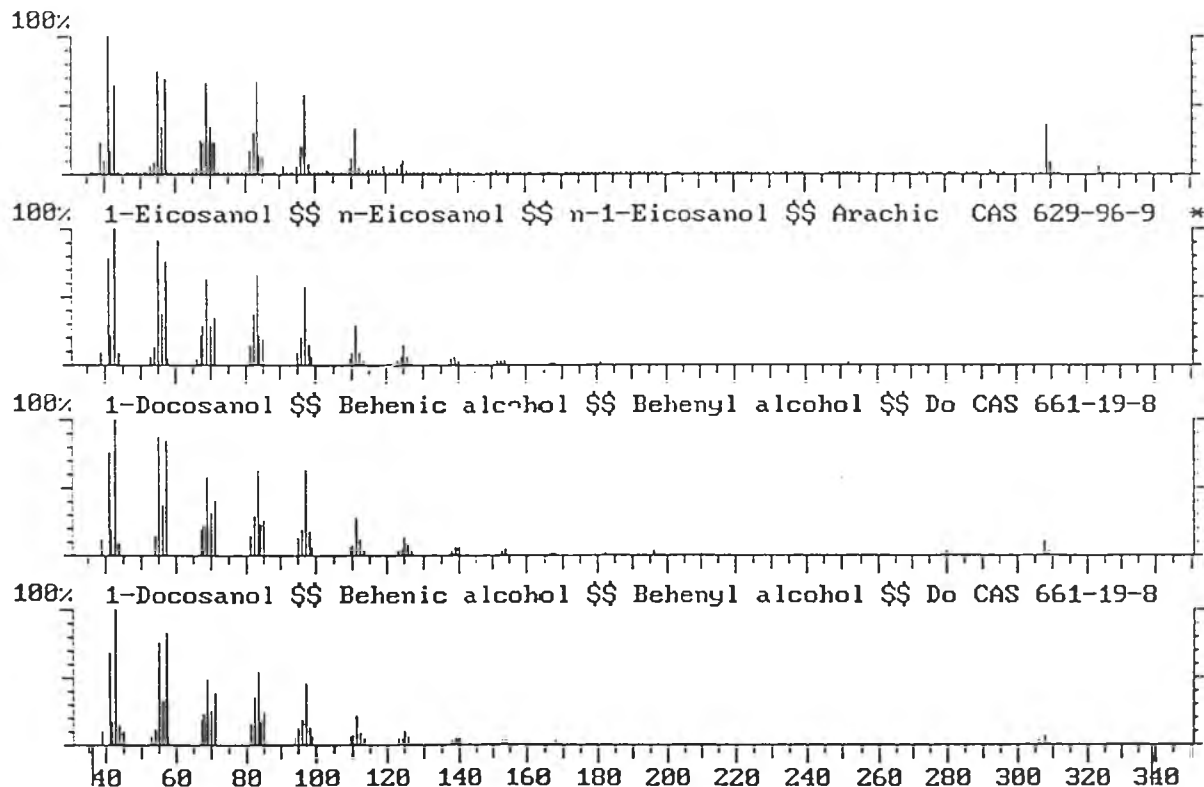
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Library search 3:



Formula C₂₈H₄₂ Rank 1 Index 112343
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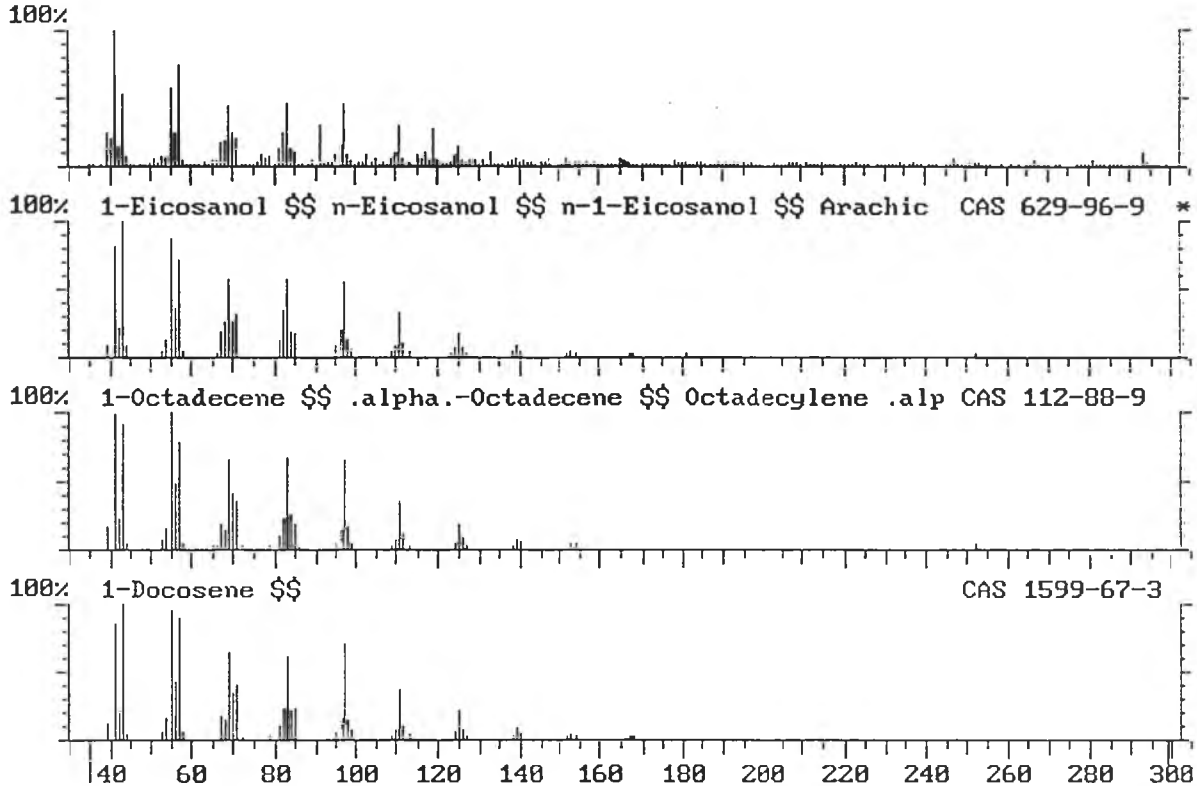
Library search 4:



Formula C₂₈H₄₂O Rank 4 Index 109474
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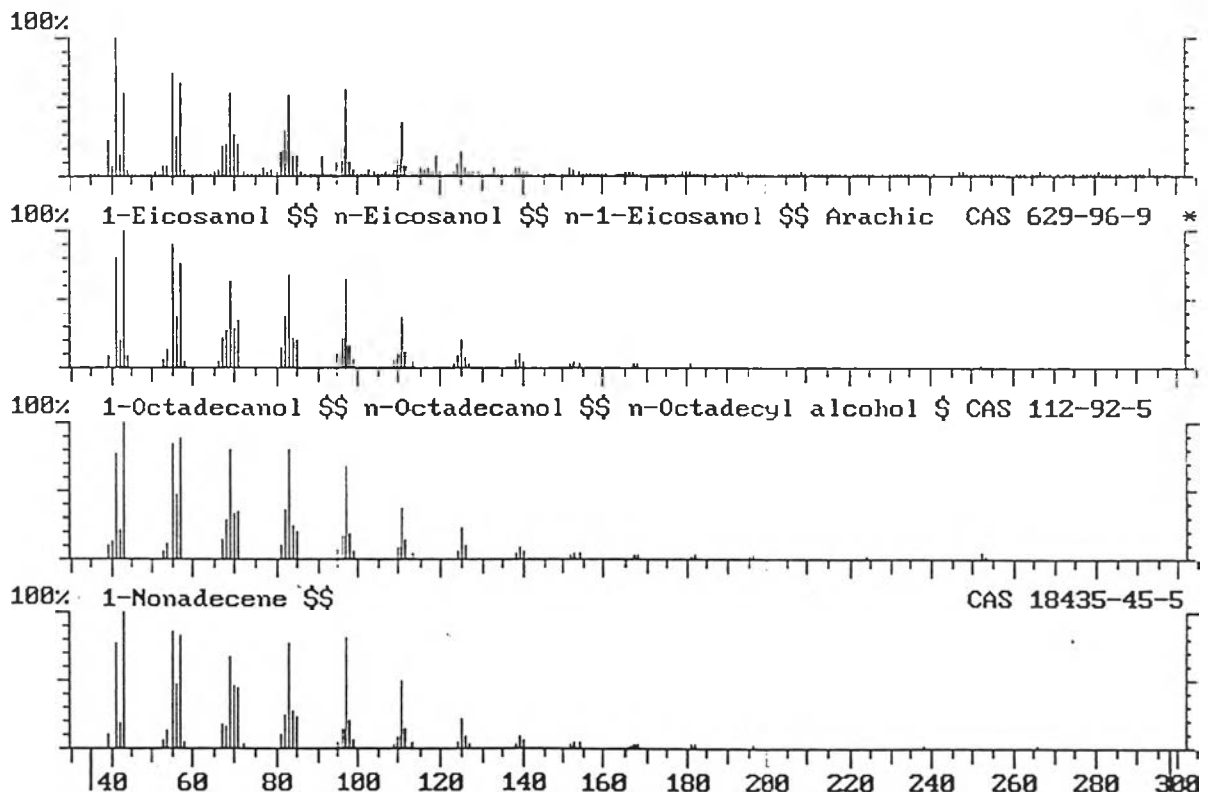
Library search 5:

Comment:



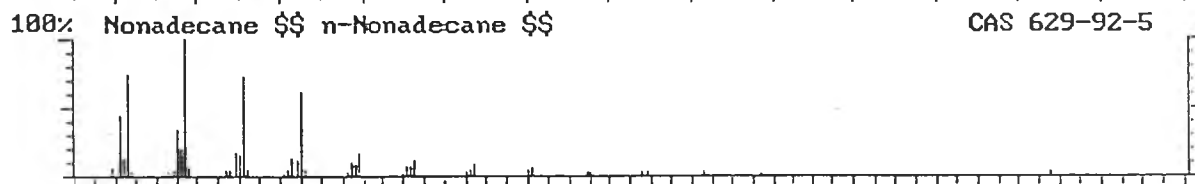
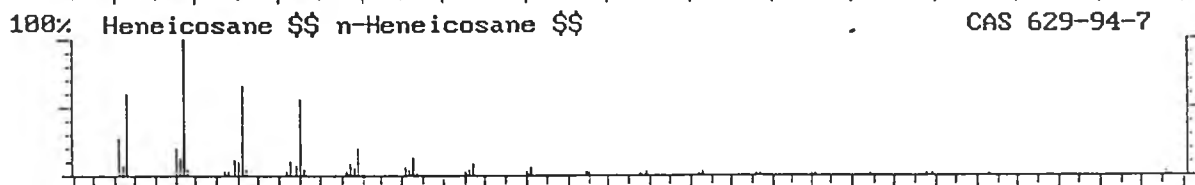
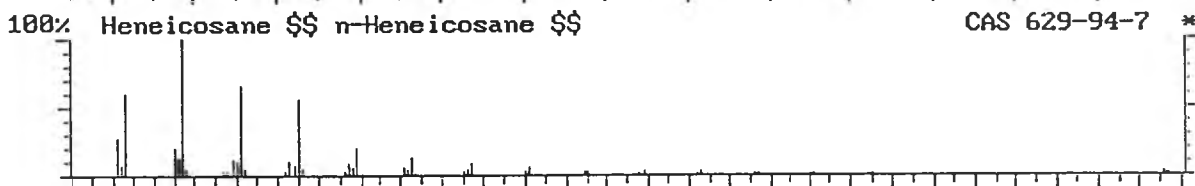
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Library search 6:



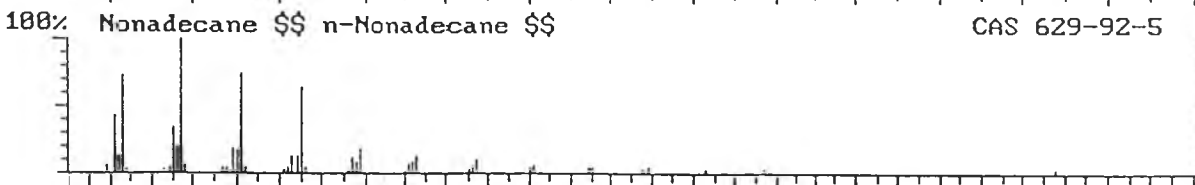
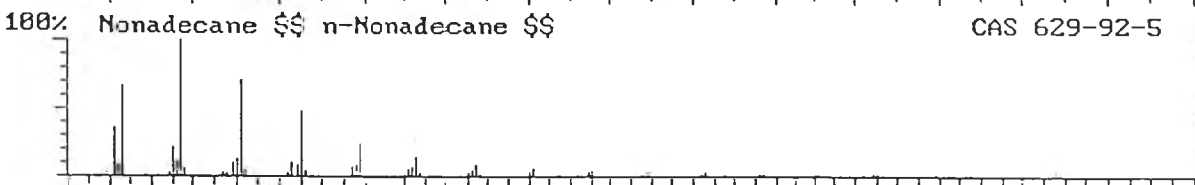
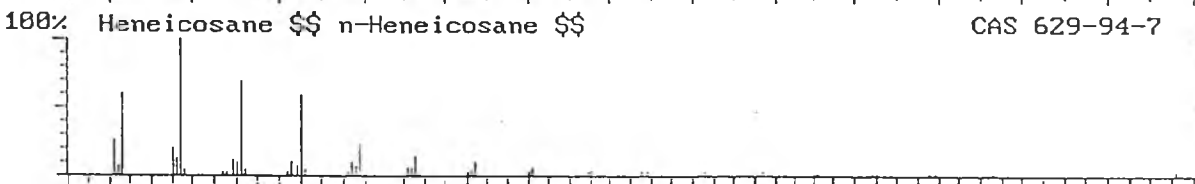
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Library search 7:



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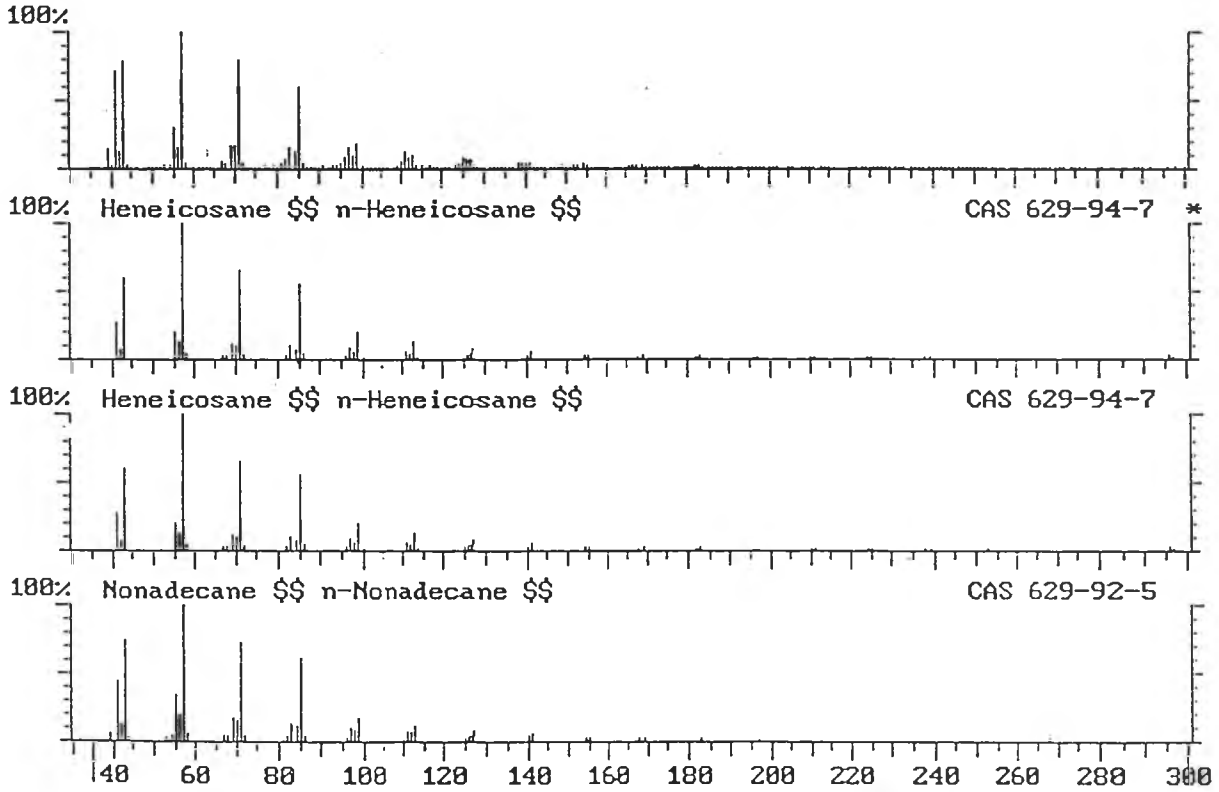
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Library search 9:

Comment:



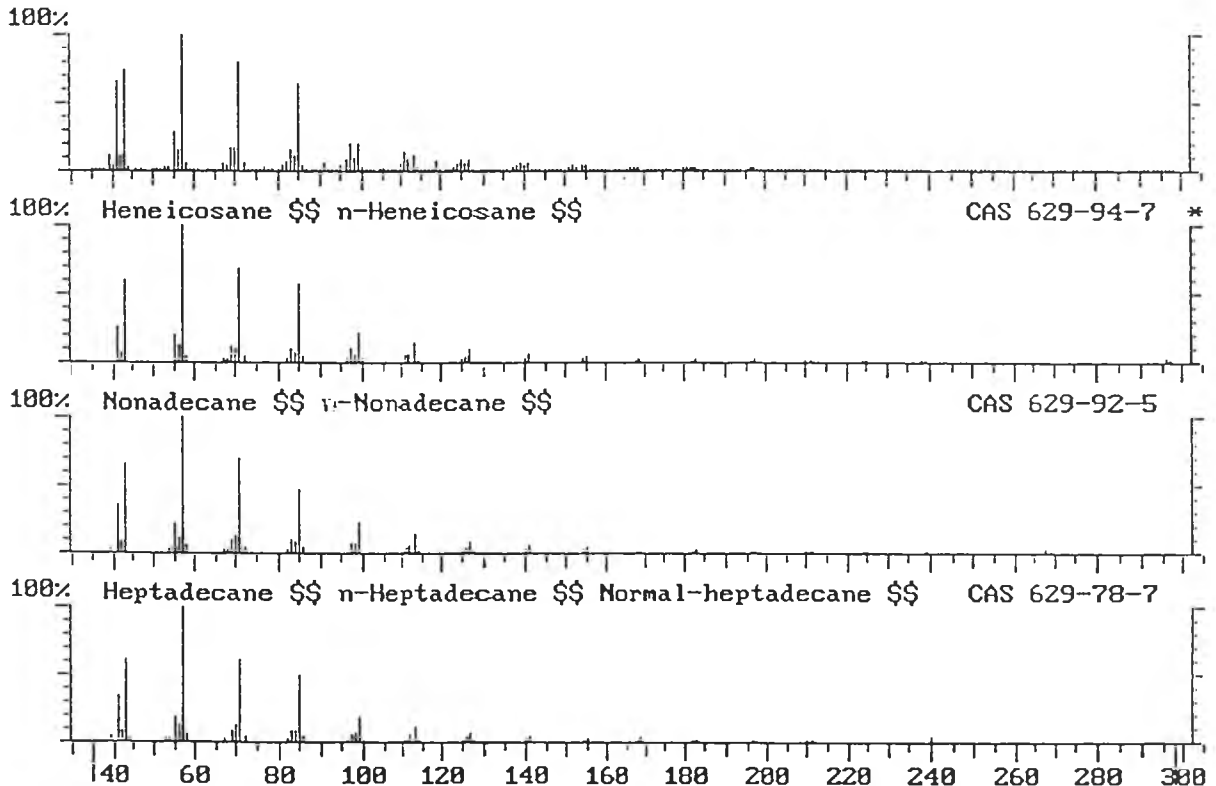
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100% Heneicosane \$\$ n-Heneicosane \$\$ CAS 629-94-7

100% Nonadecane \$\$ n-Nonadecane \$\$ CAS 629-92-5

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Library search 10:



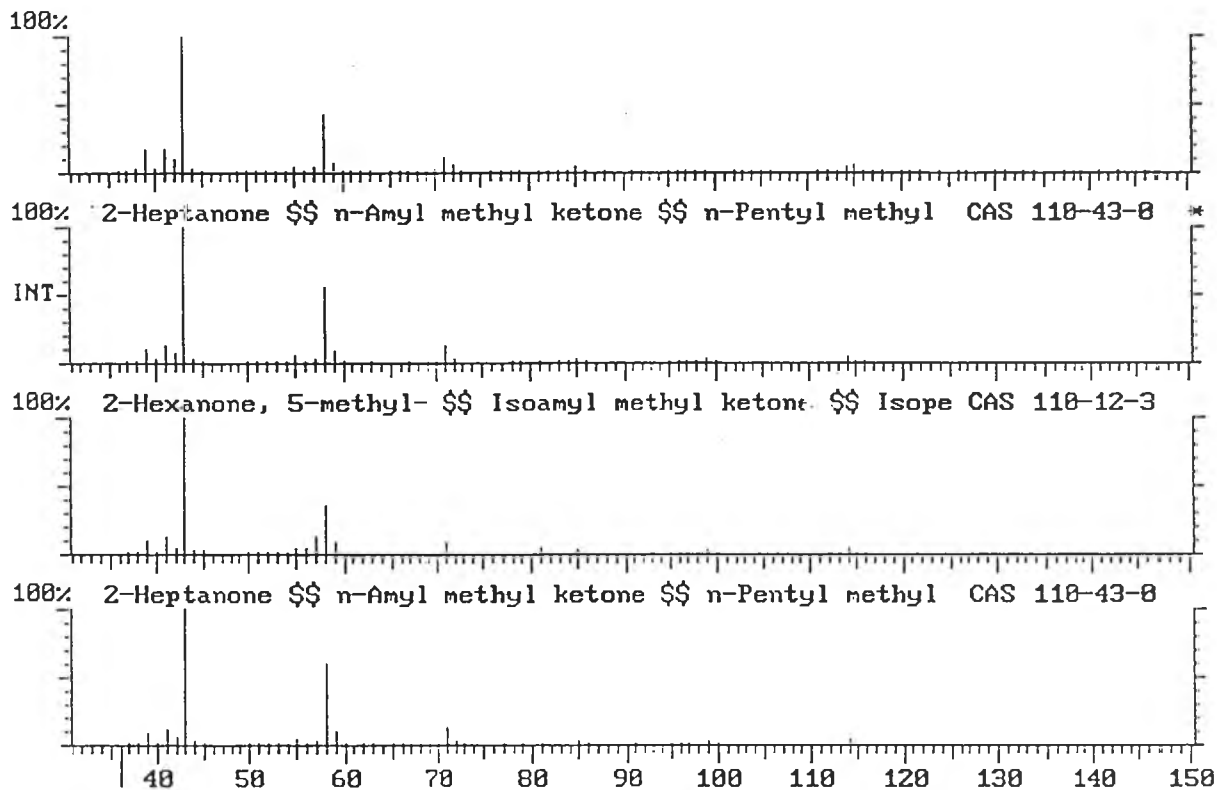
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100% Nonadecane \$\$ n-Nonadecane \$\$ CAS 629-92-5

100% Heptadecane \$\$ n-Heptadecane \$\$ Normal-heptadecane \$\$ CAS 629-78-7

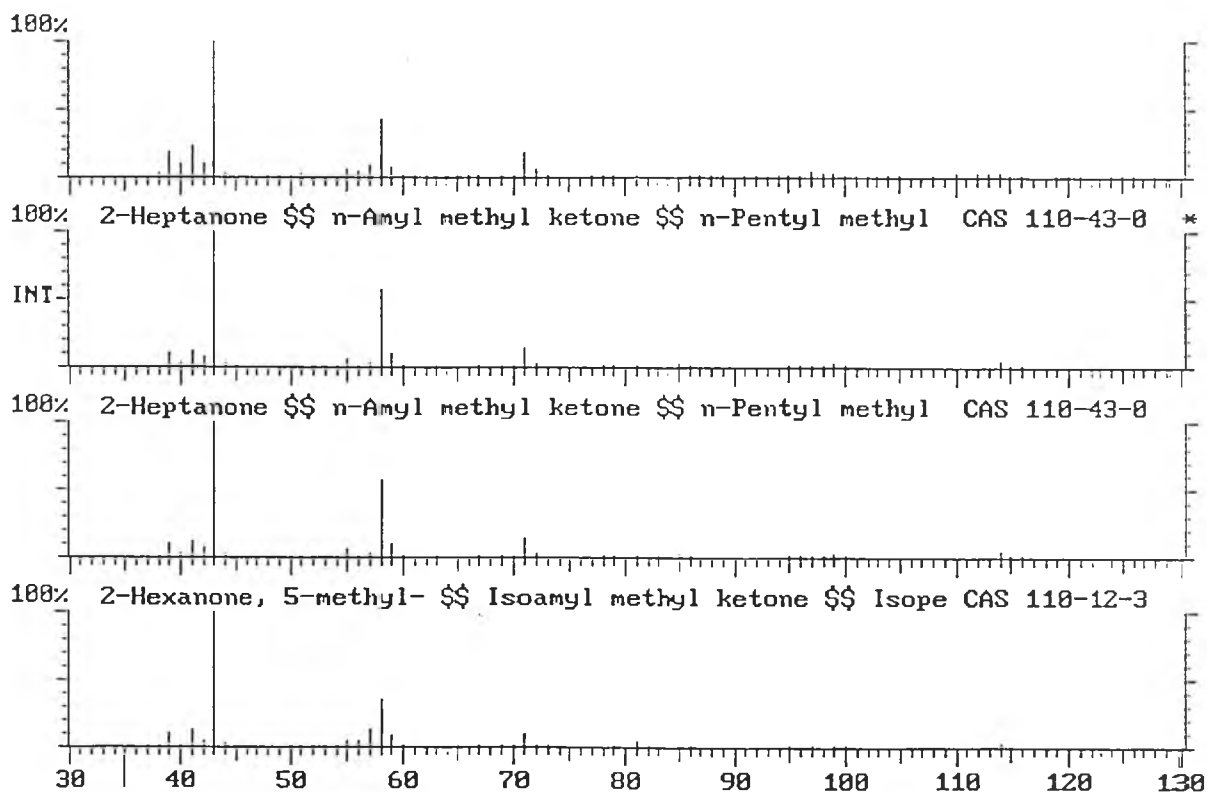
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Library search 11:



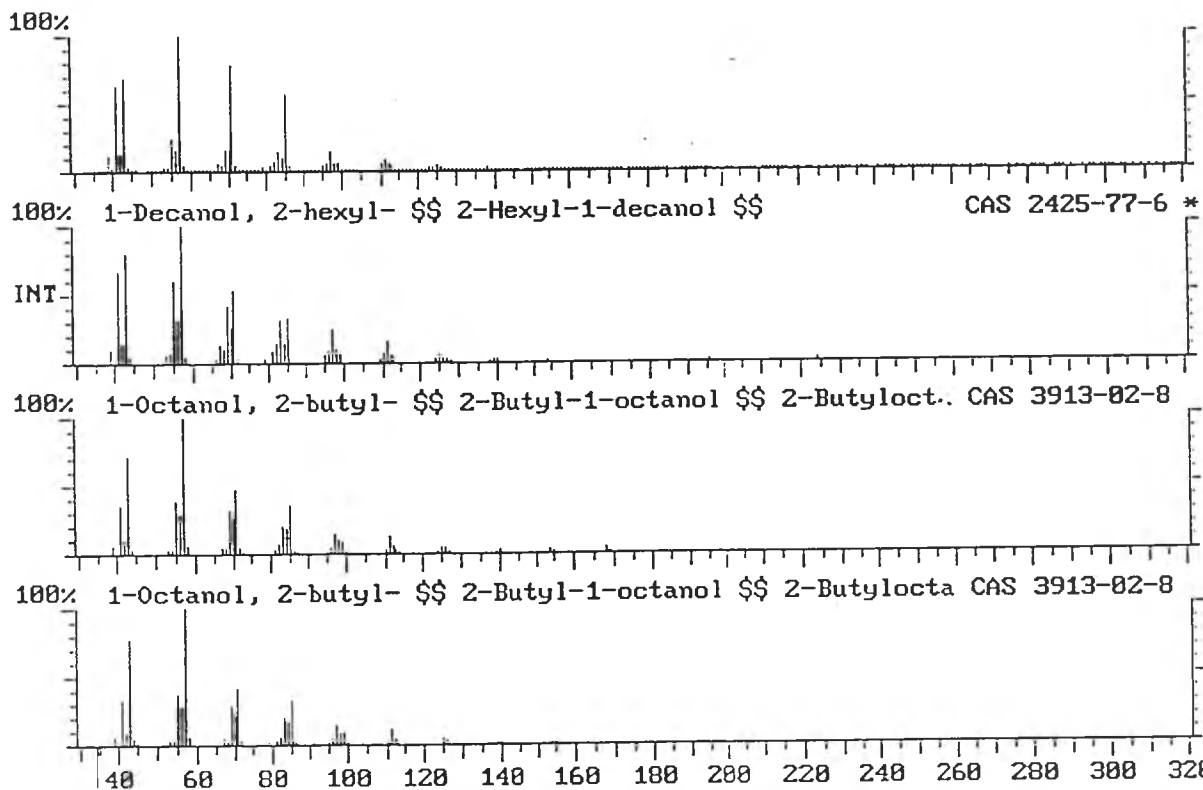
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Library search 12:



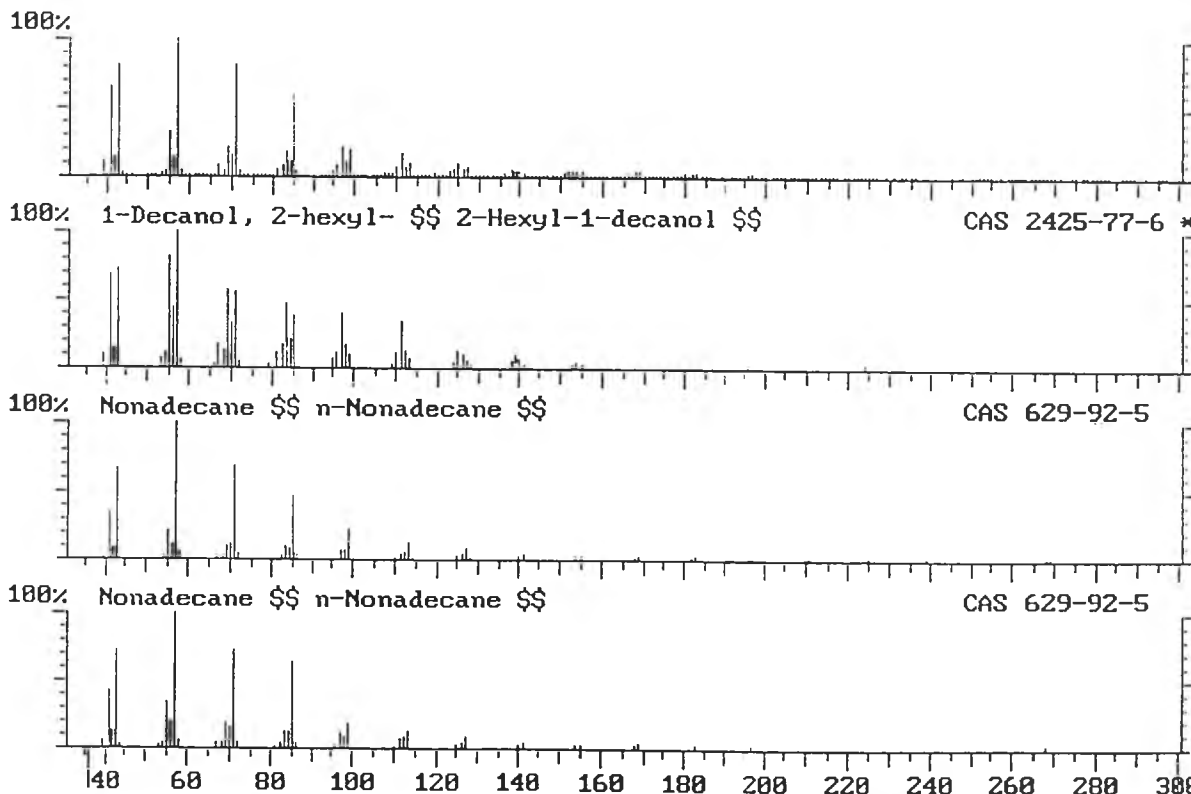
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Library search 13:



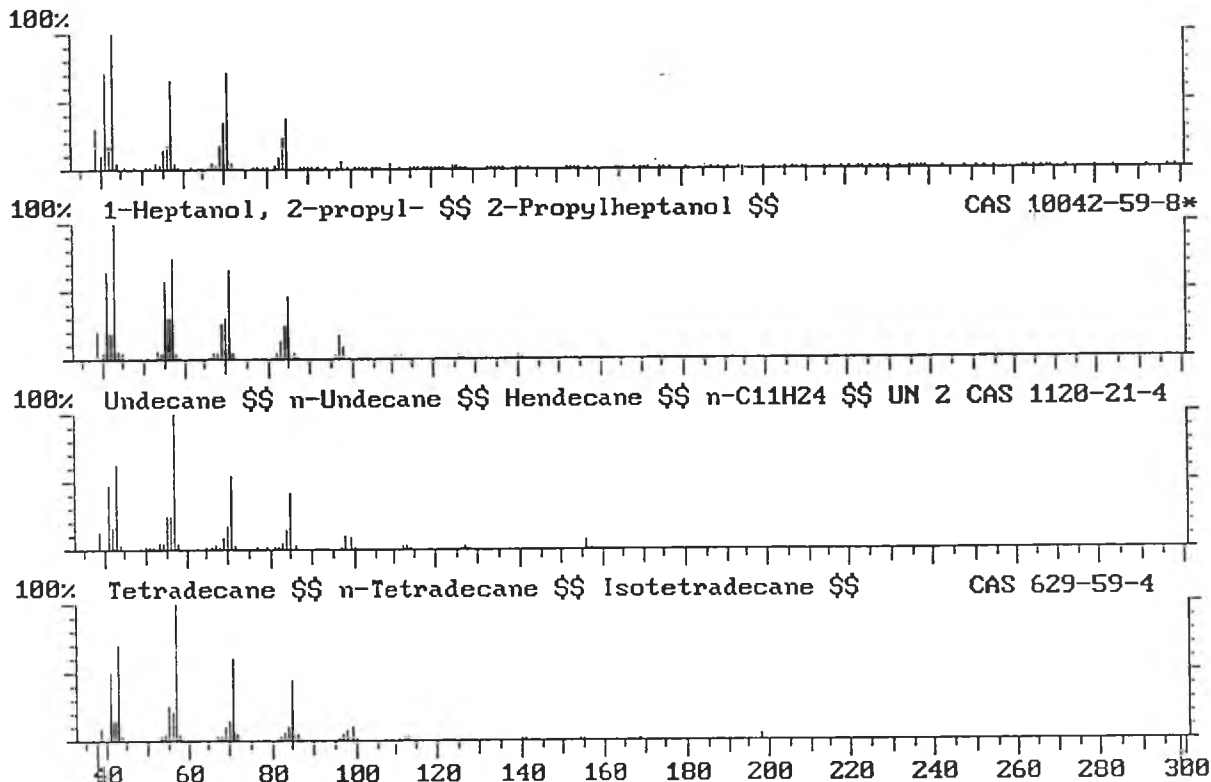
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Library search 15:



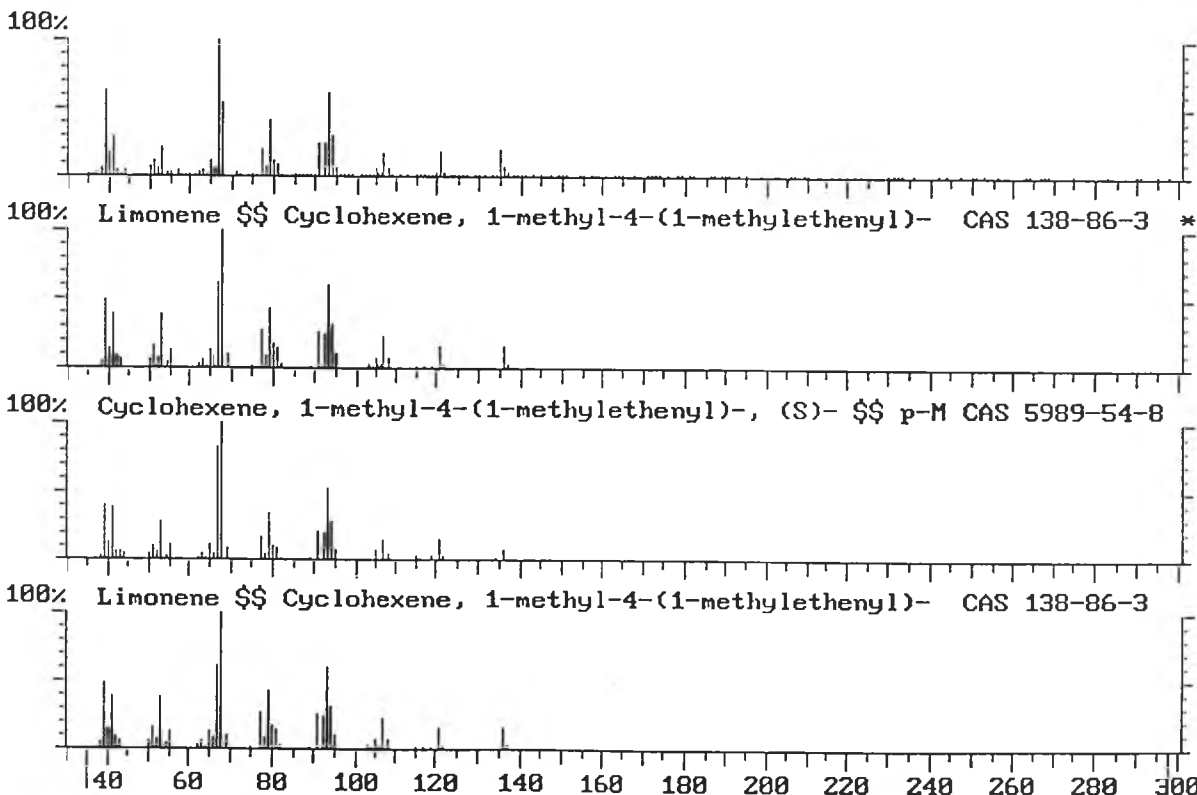
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100% Undecane \$\$ n-Undecane \$\$ Hendecane \$\$ n-C11H24 \$\$ UN 2 CAS 1120-21-4

100% Tetradecane \$\$ n-Tetradecane \$\$ Isotetradecane \$\$ CAS 629-59-4

Formula C10.H22.O Rank 1 Index 5637
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Library search 16:



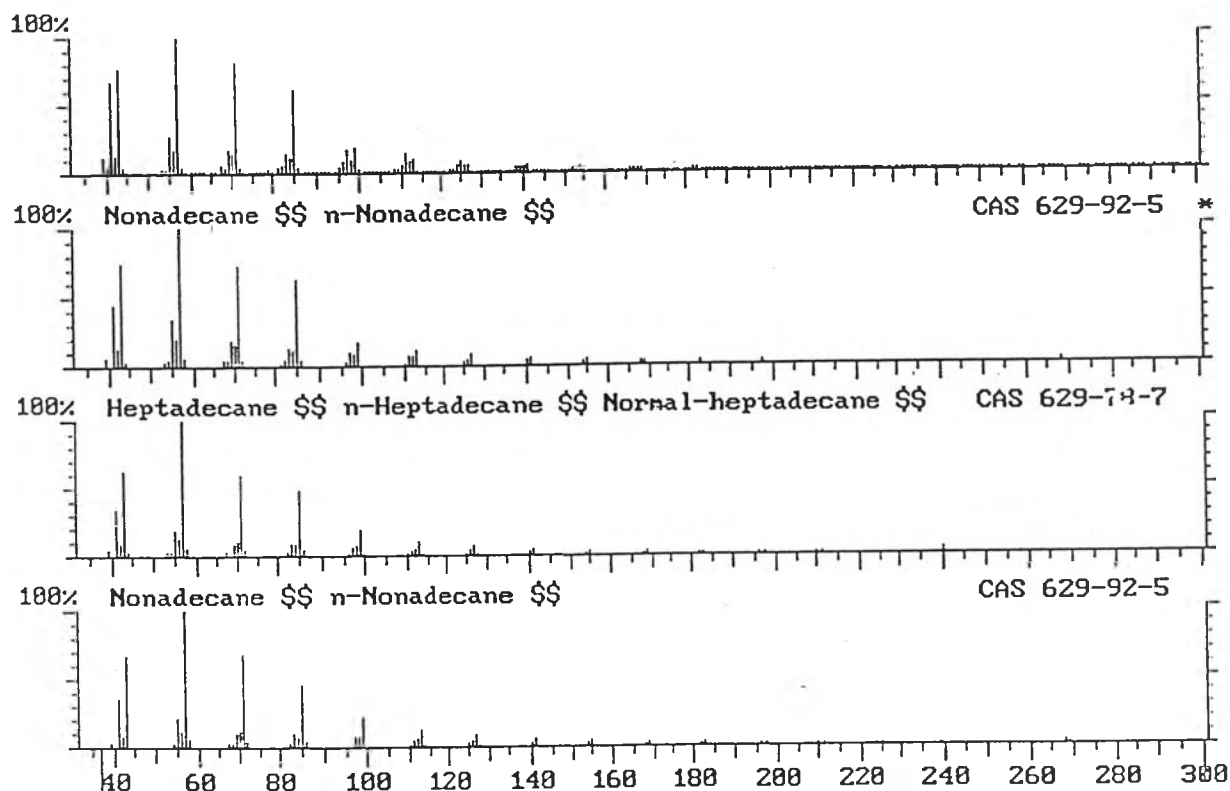
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100% Cyclohexene, 1-methyl-4-(1-methylethenyl)-, (S)- \$\$ p-M CAS 5989-54-8

100% Limonene \$\$ Cyclohexene, 1-methyl-4-(1-methylethenyl)- CAS 138-86-3

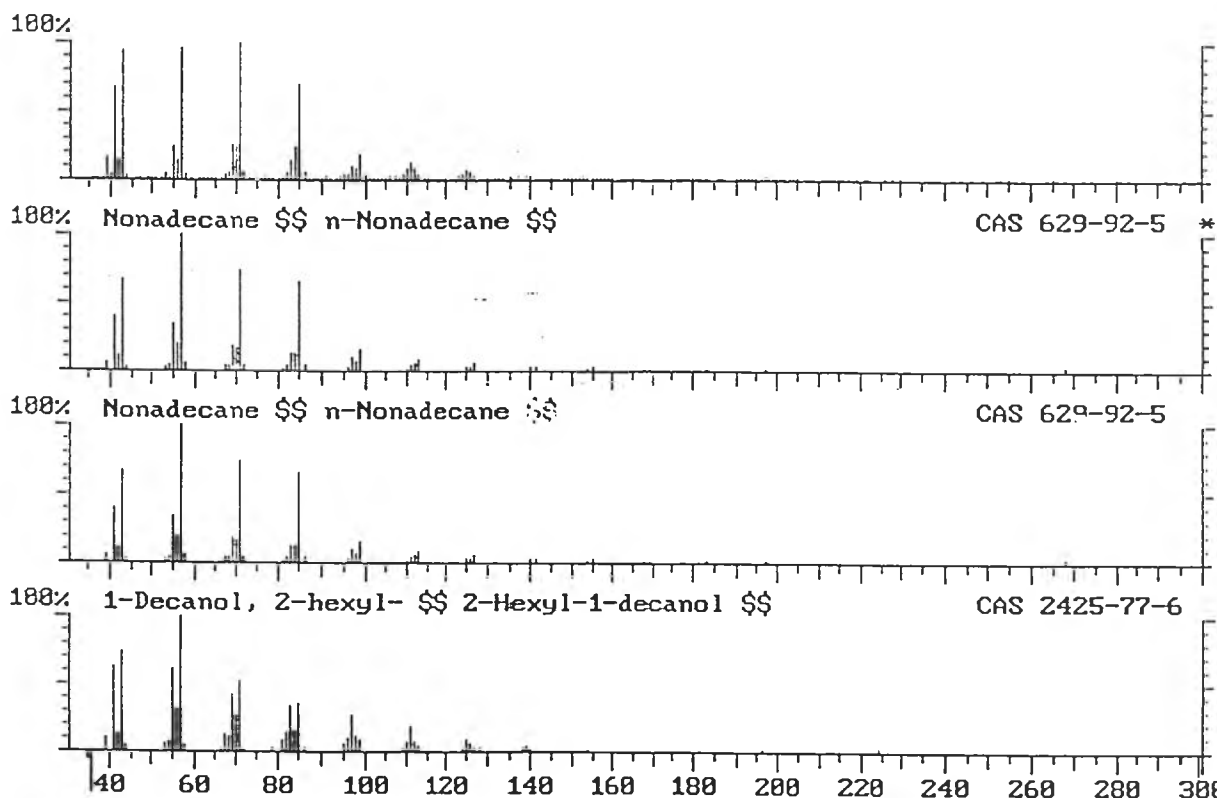
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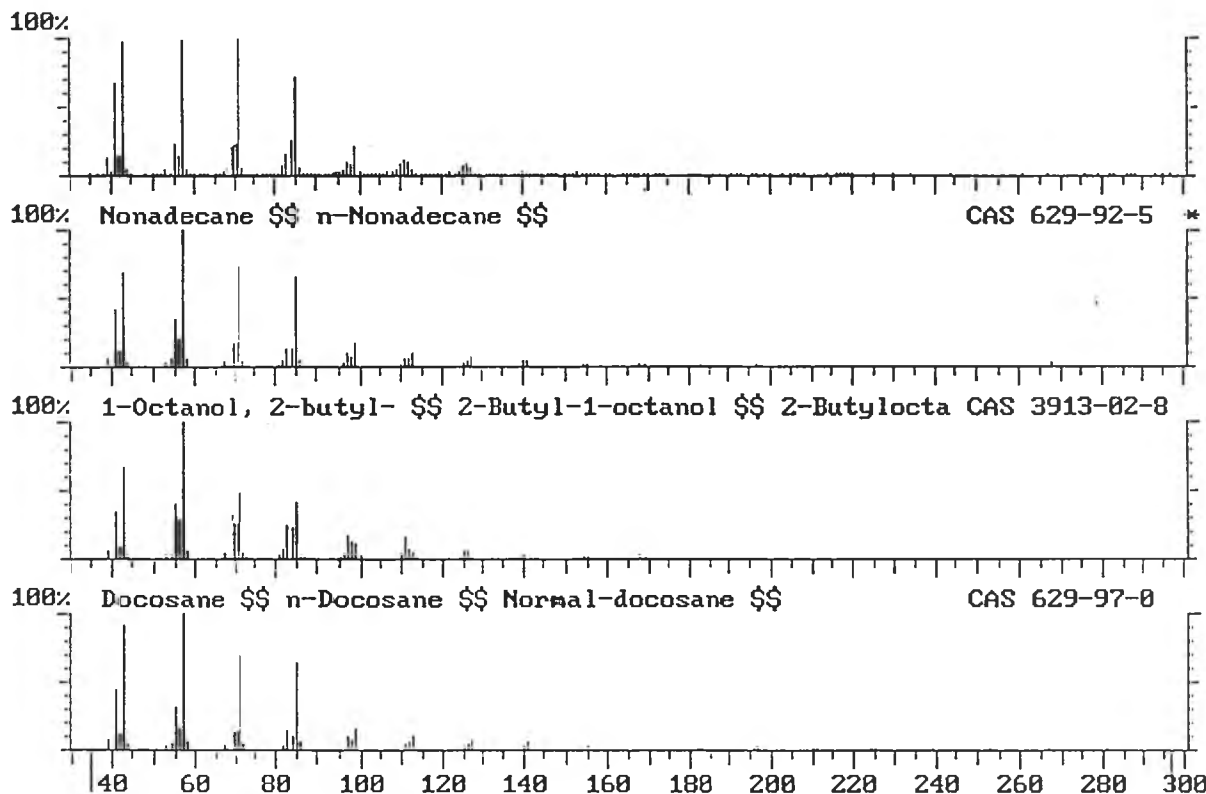
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MolWeight:268 Search:Acq LocalNorm:0n P:769 F:952 R:788 CAS# 629-92-5

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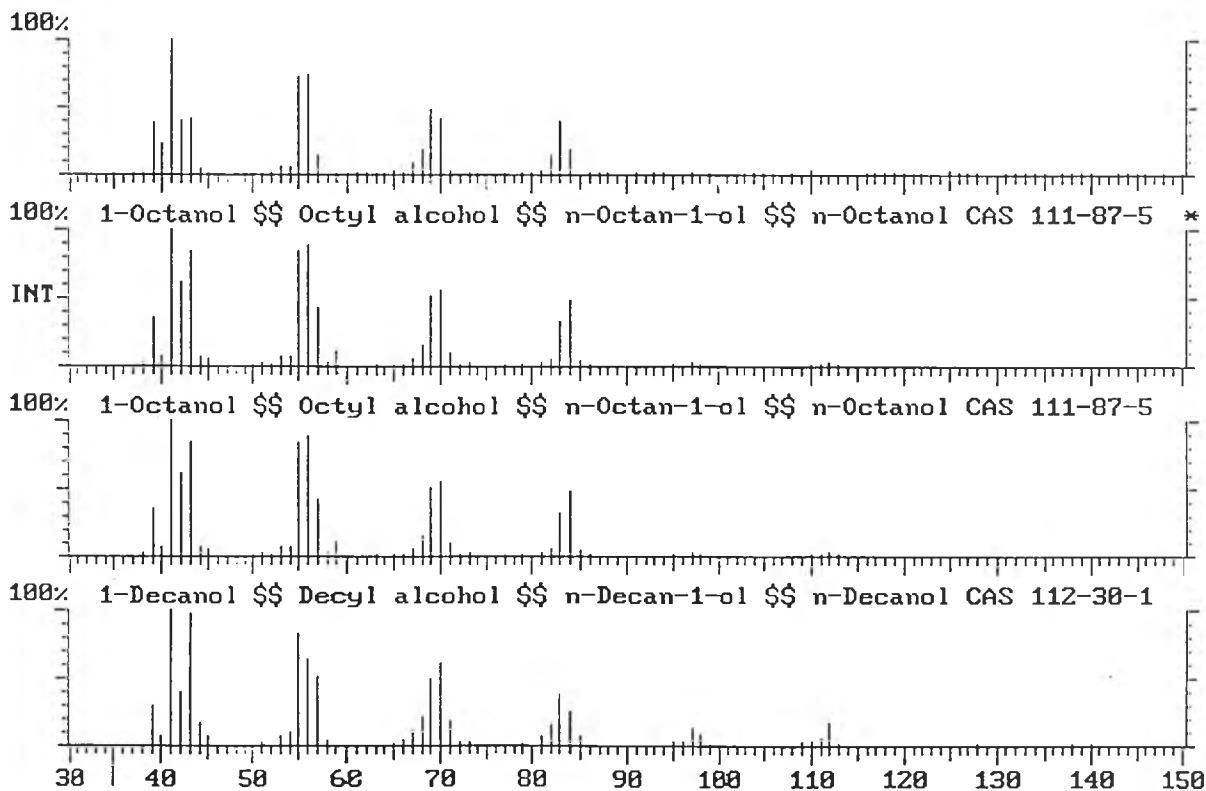
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MolWeight:268 Search:Acq LocalNorm:0n P:808 F:925 R:332 CAS# 629-92-5

Library search 19:



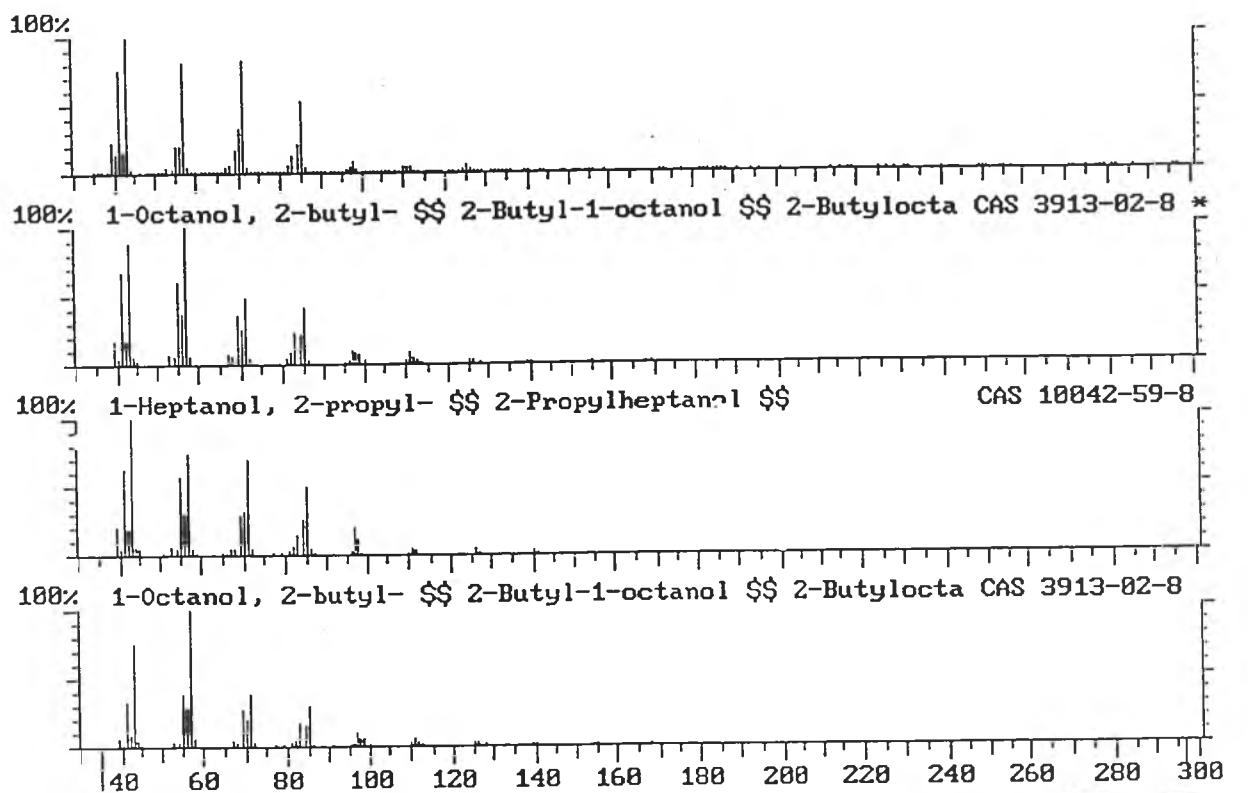
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MolWeight:268 Search:Acq LocalNorm:0n P:858 F:928 R:375 CAS# 629-92-5

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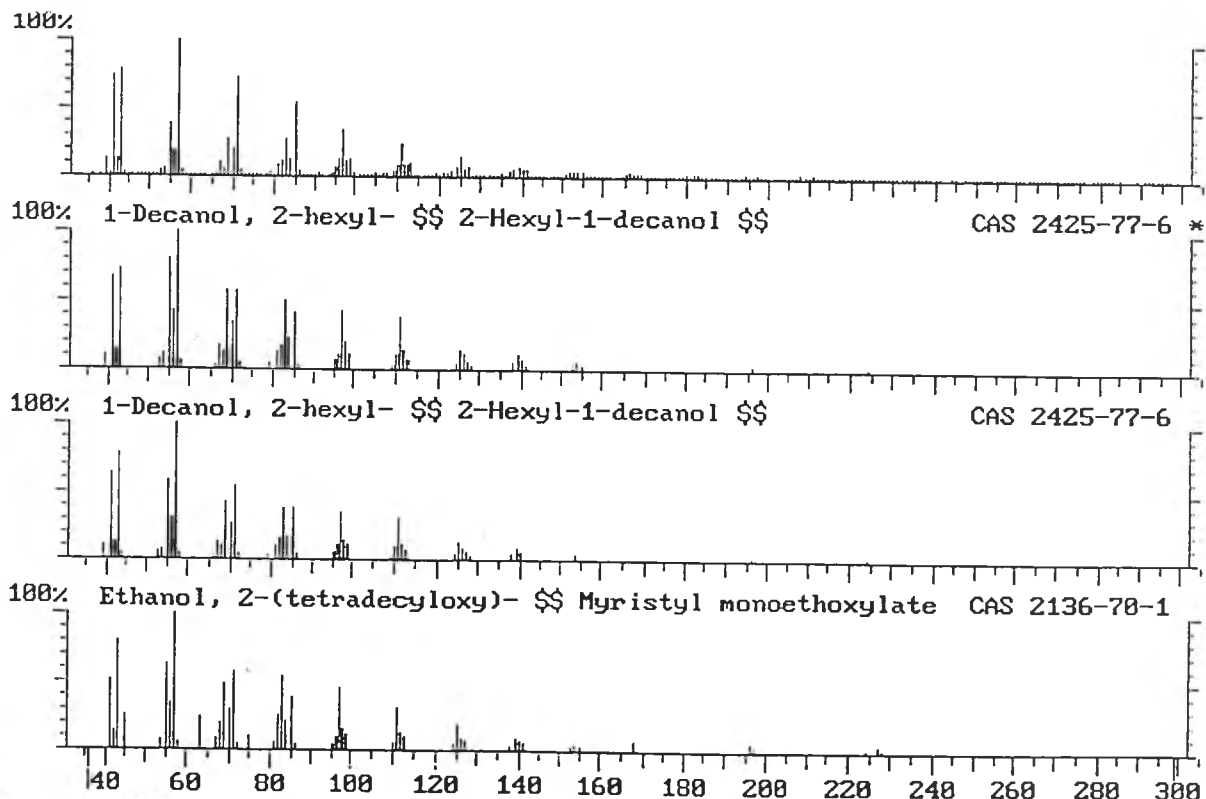
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Library search 21:



Formula C12.H26.0 Rank 1 Index 109569
MolWeight:186 Search:Acq LocalNorm:On P:867 F:927 R:380 CAS# 3913-02-8

Library search 22:



Formula C16.H34.0 Rank 1 Index 16763
MolWeight:242 Search:Acq LocalNorm:On P:758 F:953 R:765 CAS# 2425-77-6

APPENDIX IV

Table 7.12 Retention times of peak #7 of the mandibular gland extraction of *Apis andreniformis* foragers.

No. of injections	Ret Time of 2-Heptanone (min)	Ret Time of n-octyl acetate (min.)	Relative Ret Time of 2-H/ n-octyl acetate
1	6.007	12907	0.466
2	6.009	12921	0.466
3	6.010	12909	0.466
4	6.013	12897	0.465
5	6.014	12913	0.467
X ± SE	6.010±0.002	12909.40±7.80	0.466±001

Table 7.13 Retention times of peak #6 of the mandibular gland extraction of *A. cerana* foragers.

No. of injections	Ret Time of 2-Heptanone (min)	Ret Time of n-octyl acetate (min.)	Relative Ret Time of 2-H/ n-octyl acetate
1	6.036	12892	0.468
2	6.032	12901	0.467
3	6.035	12896	0.468
4	6.039	12889	0.468
5	6.037	12883	0.468
X ± SE	6.036±0.002	12892.20±6.112	0.468 ± 0.0004

Table 7.14 Retention times of peak #8 of the mandibular gland extraction of *A. dorsata* foragers.

No. of injections	Ret Time of 2-Heptanone (min)	Ret Time of n-octyl acetate (min.)	Relative Ret Time of 2-H/ n-octyl acetate
1	6.073	13010	0.466
2	6.075	13003	0.467
3	6.071	13015	0.466
4	6.070	13017	0.466
5	6.074	13006	0.467
X ± SE	6.073± 0.0018	13010.20±5.268	0.466±0.005

Table 7.15 Retention times of peak #5 of the mandibular gland extraction of *A. mellifera* foragers.

No. of injections	Ret Time of 2-Heptanone (min)	Ret Time of n-octyl acetate (min.)	Relative Ret Time of 2-H/ n-octyl acetate
1	5.862	12514	0.468
2	5.871	12517	0.468
3	5.861	12520	0.468
4	5.860	12511	0.468
5	5.858	12509	0.467
X ± SE	5.862±0.005	12514.20±3.969	0.468±0.0004

Table 7.16 Peak area of 1.0E-003 ml/ml of 2-heptanone in n-hexane and n-octyl acetate

No. of injections	Peak area of 2-Heptanone	Peak area of n-octyl acetate	Relative peak area of 2-H/ n-octyl acetate
1	8940	128277	0.069
2	8941	128270	0.069
3	8936	128284	0.069
4	8942	128276	0.068
5	8939	128280	0.069
X ± SE	8939.8±2.31	128277.3± 4.53	0.069±0.0005

Table 7.17 Peak area of 1.5E-003 ml/ml of 2-heptanone in n-hexane and n-octyl acetate

No. of injections	Peak area of 2-Heptanone	Peak area of n-octyl acetate	Relative peak area of 2-H/ n-octyl acetate
1	13622	128319	0.106
2	13616	128290	0.106
3	13627	128329	0.106
4	13631	128333	0.106
5	13618	128320	0.106
X ± SE	13622.8±5.556	128318.20±15.065	0.106±0.00

Table 7.18 Peak area of 2.0E-003 ml/ml of 2-heptanone in n-hexane and n-octyl acetate

No. of injections	Peak area of 2-Heptanone	Peak area of n-octyl acetate	Relative peak area of 2-H/ n-octyl acetate
1	17957	128263	0.140
2	17950	128267	0.139
3	17963	128259	0.140
4	17970	128268	0.140
5	17948	128257	0.140
X ± SE	17957.20±7.05	128262.8±4.308	0.1398±0.0005

Table 7.19 Peak area of 3.0E-003 ml/ml of 2-heptanone in n-hexane and n-octyl acetate

No. of injections	Peak area of 2-Heptanone	Peak area of n-octyl acetate	Relative peak area of 2-H/ n-octyl acetate
1	25536	128271	0.195
2	25541	128276	0.195
3	25545	128273	0.195
4	25529	128287	0.194
5	25541	128279	0.195
X ± SE	25538.4±5.418	128277.2±5.60	0.195±0.0004

Table 7.20 Peak areas of 4.0E-003 ml/ml of 2-heptanone in n-hexane and n-octyl acetate

No. of injections	Peak area of 2-Heptanone	Peak area of n-octyl ecetate	Relative peak area of 2-H/ n-octyl acetate
1	36050	129297	0.279
2	36073	129290	0.279
3	36087	129311	0.279
4	36093	129300	0.279
5	36058	129252	0.278
X ± SE	36072.4±16.24	129290±20.169	0.279±0.0004

Table 7.21 Peak area of of peak #7 of the mandibular gland extraction of *A. andreniformis* foragers and n-octyl acetate.

No. of injections	Peak area of 2-Heptanone	Peak area of n-octyl ecetate	Relative peak area of 2-H/ n-octyl acetate
1	550	122724	0.005
2	558	122718	0.005
3	543	122729	0.004
4	546	122735	0.004
5	553	122716	0.005
X ± SE	550.2±5.114	122724.4±6.97	0.0046±0.0005

Table 7.22 Peak area of of peak #6 of the mandibular gland extraction of *A. cerana* foragers and n-octyl acetate.

No. of injections	Peak area of 2-Heptanone	Peak area of n-octyl ecetate	Relative peak area of 2-H/ n-octyl acetate
1	3049	122705	0.025
2	3034	122717	0.024
3	3054	122703	0.025
4	3051	122701	0.025
5	3059	122700	0.025
X ± SE	3049.4±8.40	122705±6.144	0.025±0.0004

Table 7.23 Peak area of of peak #8 of the mandibular gland extraction of *A. andreniformis* foragers and n-octyl acetate.

No. of injections	Peak area of 2-Heptanone	Peak area of n-octyl ecetate	Relative peak area of 2-H/ n-octyl acetate
1	1080	120437	0.009
2	989	120498	0.008
3	1095	120420	0.009
4	1052	120414	0.009
5	1185	120418	0.009
X ± SE	1080.2±63.24	120437.4±31.30	0.009±0.0004

Table 7.24 Peak area of of peak #5 of the mandibular gland extraction of *A. mellifera* foragers and n-octyl acetate.

No. of injections	Peak area of 2-Heptanone	Peak area of n-octyl ecetate	Relative peak area of 2-H/ n-octyl acetate
1	14947	116857	0.128
2	14951	116890	0.128
3	14986	116846	0.128
4	14935	116889	0.128
5	14920	116801	0.128
<i>X ± SE</i>	<i>14946.8±20.22</i>	<i>118856.6±32.769</i>	<i>0.128.0±0.00</i>

BIOGRAPHY

Mrs. Guntima Suwannapong was born on December 24, 1967 in Roi-Et Province, Thailand. She graduated with Bachelor and Master degrees of Science in Zoology, Department of Biology, Faculty of Science, Chulalongkorn University in 1989 and 1992, respectively. She has worked at Department of Biology, Faculty of Science, Burapha University since 1993. She has studied for Doctor's degree in Biological Science at Faculty of Science, Chulalongkorn University since 1997.

