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## Appendix A

### Determination of Degree of Deacetylation of Chitosan

#### Method of calculation

Sample: CTS3A ( see Table in the following page)

#### *Sample solution*

Weight of sample (Chitosan hydrochloride) 1.0130 gm  
dissolved in water to 250 ml

#### *Titration*

Chitosan hydrochloride solution used 50.0 ml  
Volume of standard NaOH (0.0876 N.) used 7.910 ml

#### *Calculation*

Chitosan hydrochloride 1 mol. (197.61672 gm)  $\equiv$  NaOH 1 mol.

The amount of monomer having  $\text{NH}_2$  group in sample 1.0130 gm  
 $= 0.003465$  mol.  
 $= 0.6847$  gm

The amount of monomer having  $\text{NHCOCH}_3$  group in sample 1.0130 gm  
 $= 1.0130 - 0.6847$  gm  
 $= 0.3283$  gm

( monomer having  $-\text{NHCOCH}_3$  1 mol = 203.19296 gm)  $= 0.001616$  mol.

The total amount of monomer in sample 1.0130 gm  $= 0.003465 + 0.001616$  mol.  
 $= 0.005081$  mol.

The degree of deacetylation  $= (0.003465 / 0.005081) \times 100$  %  
 $= 68.19$  % monomer : 100 monomer

By this method, the degree of deacetylation of various chitosans was calculated and the values are given in the table in the following page.

Determination of degree of deacetylation of chitosan.

Chitosan	wt. of CTS.HCl (gm)	vol. of NaOH used (ml)	Deacetylation (%)	mean (%)	s.d. (%)
CTS3A	1.0130	(1) 7.910	68.19	68.11	0.15
		(2) 7.880	67.94		
		(3) 7.910	68.19		
CTS3.5A	1.0100	(1) 8.360	72.21	72.21	0.00
		(2) 8.360	72.21		
		(3) 8.360	72.21		
CTS7A	1.0326	(1) 8.980	75.79	75.87	0.08
		(2) 8.990	75.87		
		(3) 9.000	75.95		
CTS73A	1.0352	(1) 9.520	80.05	79.83	0.19
		(2) 9.480	79.72		
		(3) 9.480	79.72		
CTS2.5N	1.0099	(1) 7.840	67.81	67.86	0.10
		(2) 7.860	67.97		
		(3) 7.840	67.81		
CTS3N	1.0001	(1) 8.140	71.03	71.11	0.09
		(2) 8.160	71.20		
		(3) 8.150	71.11		
CTS7N	1.0278	(1) 8.930	75.72	75.69	0.05
		(2) 8.930	75.72		
		(3) 8.920	75.64		
CTS60N	1.0203	(1) 6.820	58.53	58.51	0.05
		(2) 6.810	58.45		
		(3) 6.820	58.53		
(refluxed)	0.9975	(1) 8.500	74.29	74.14	0.14
		(2) 8.470	74.04		
		(3) 8.475	74.08		

## Appendix B

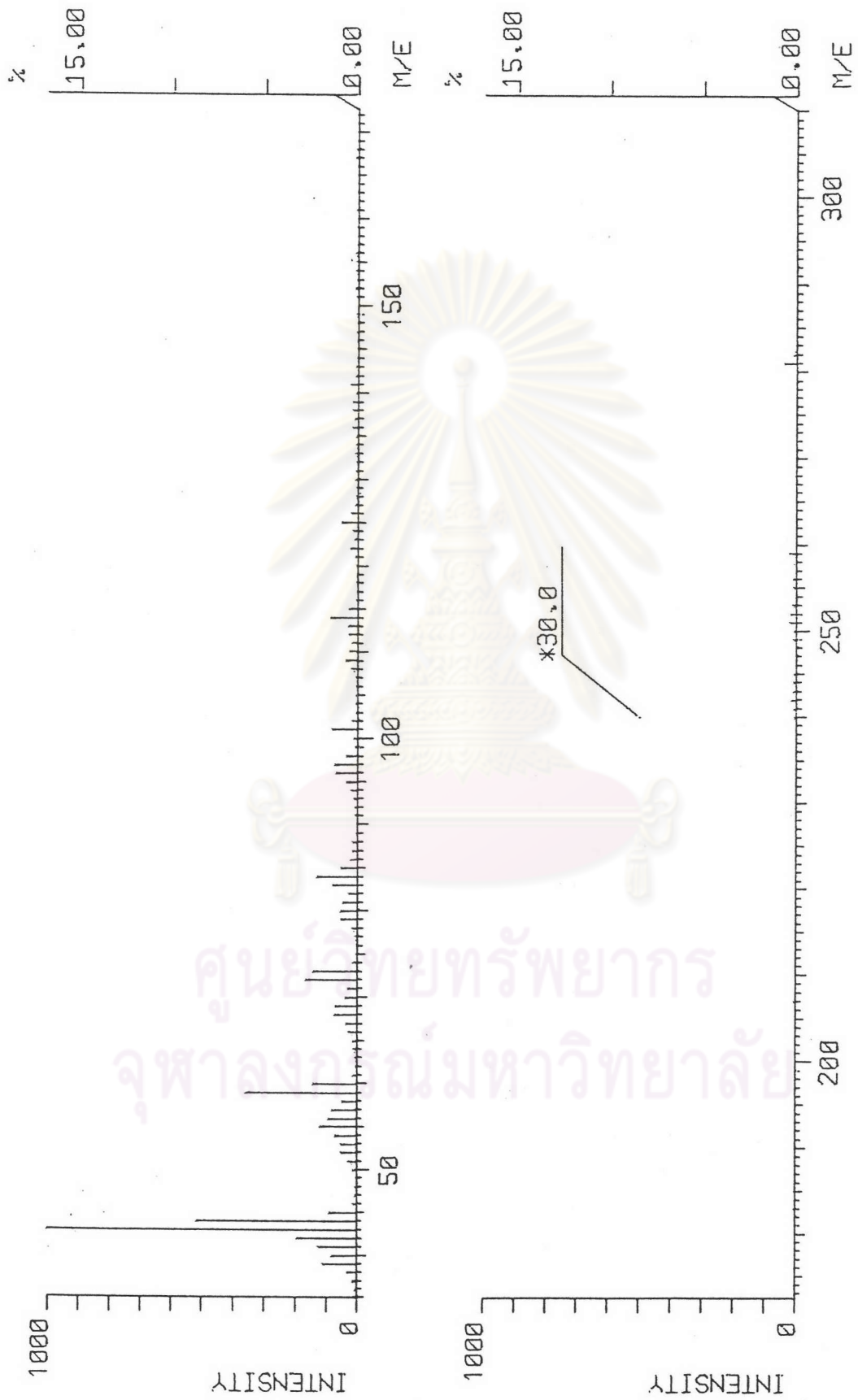
### Mass Spectrometry

The electron impact spectra of chitin and chitosan products are depicted in the following pages.

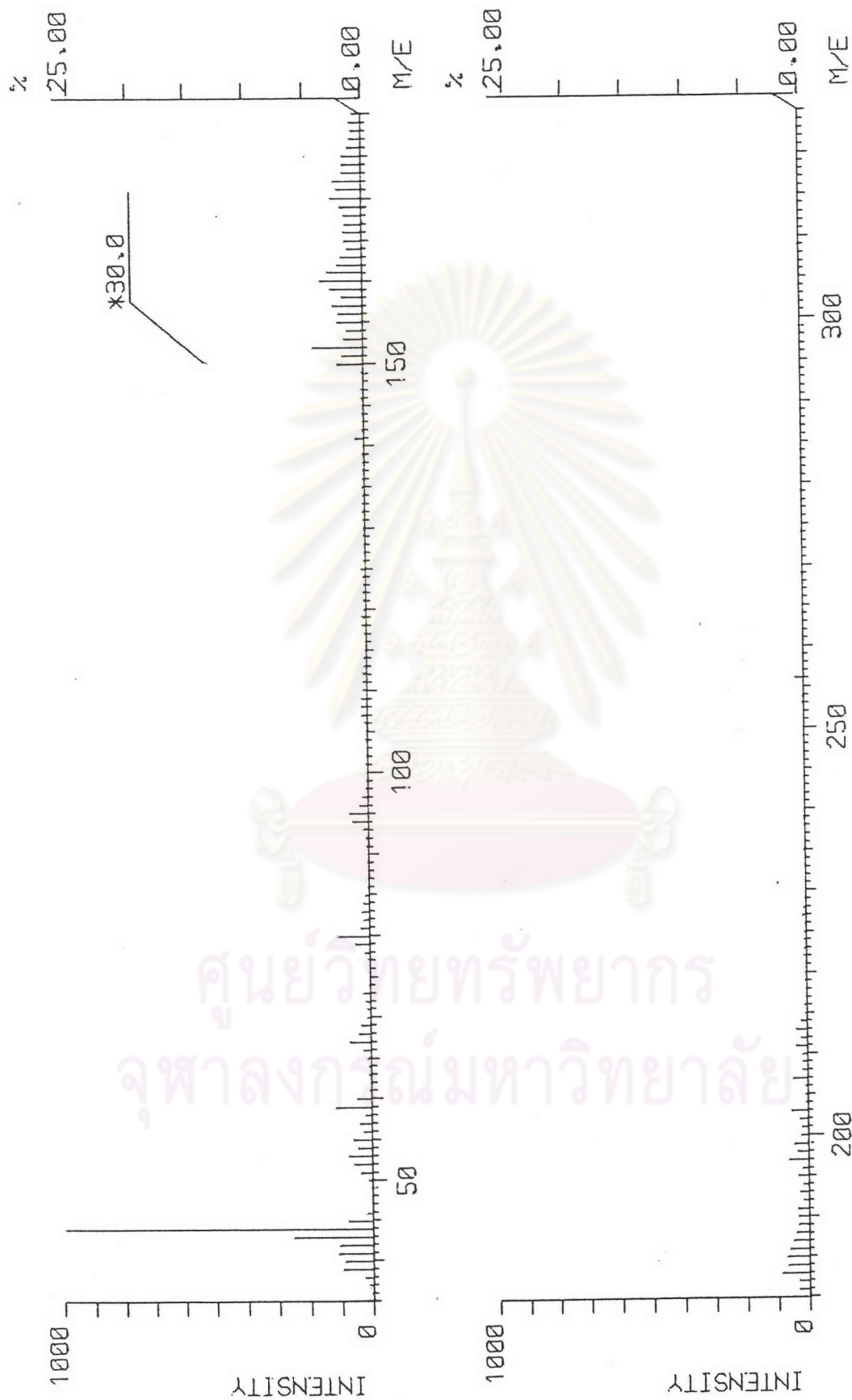


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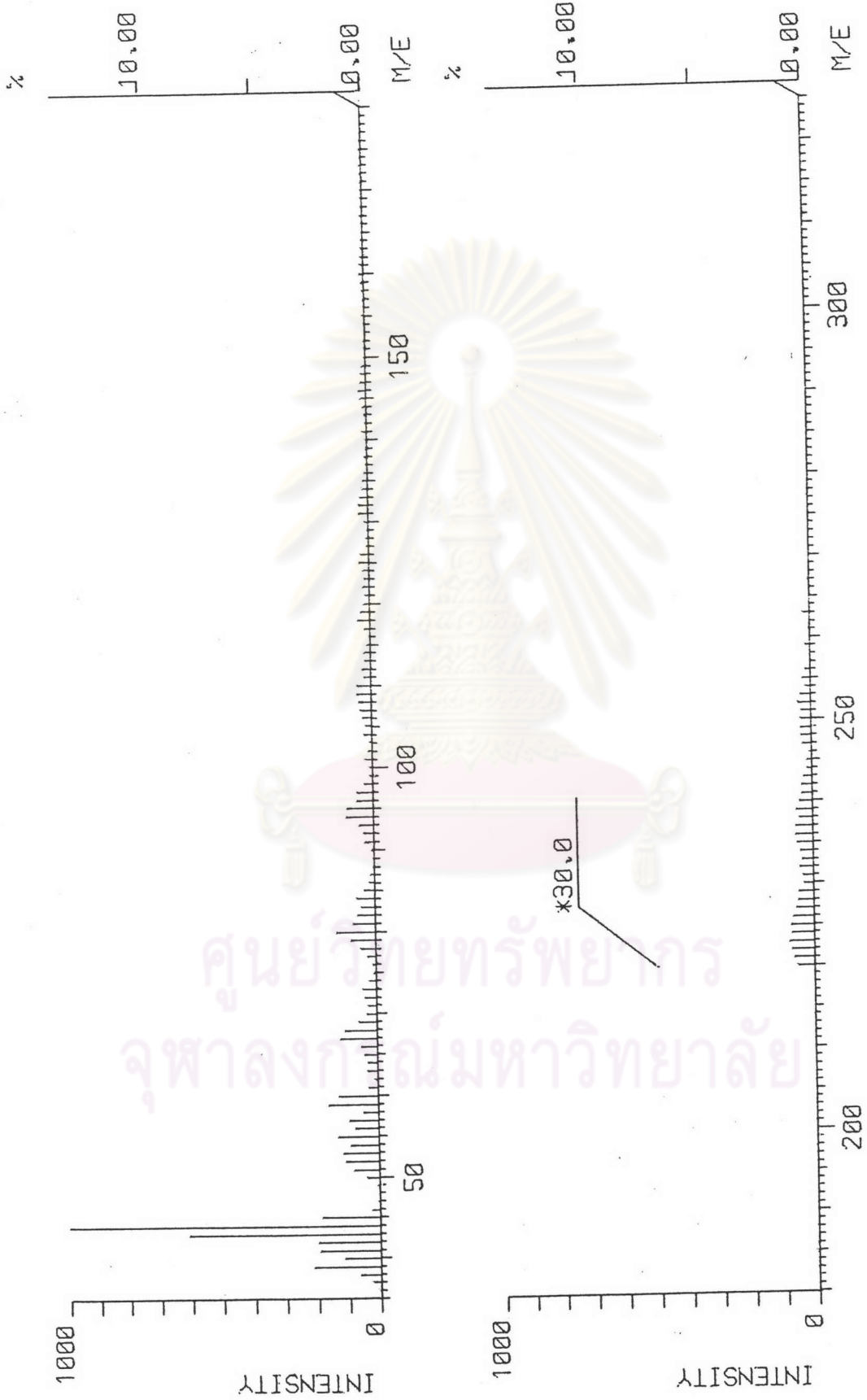


The electron impact spectrum of Chitin.



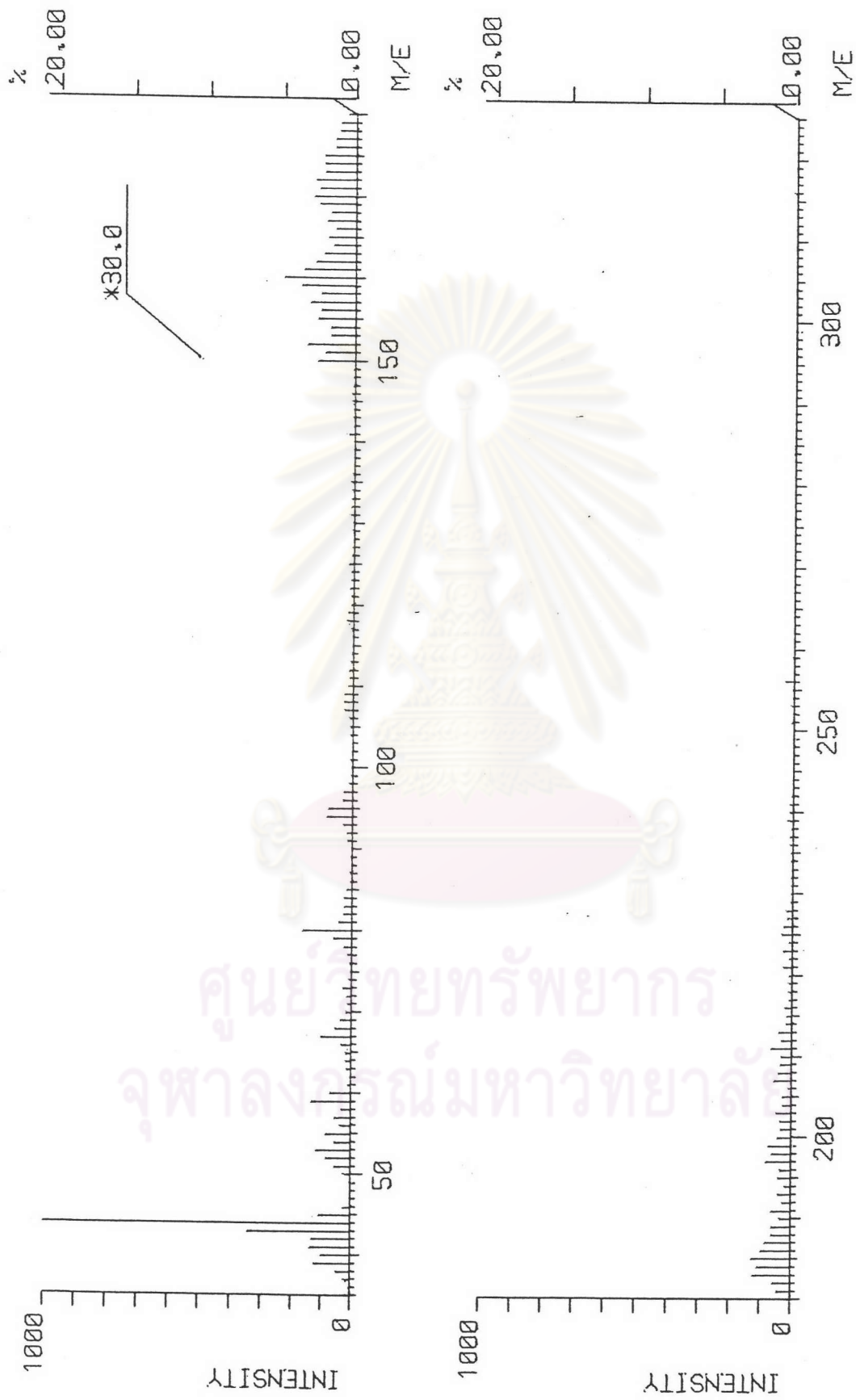
The electron impact spectrum of CTS3A.

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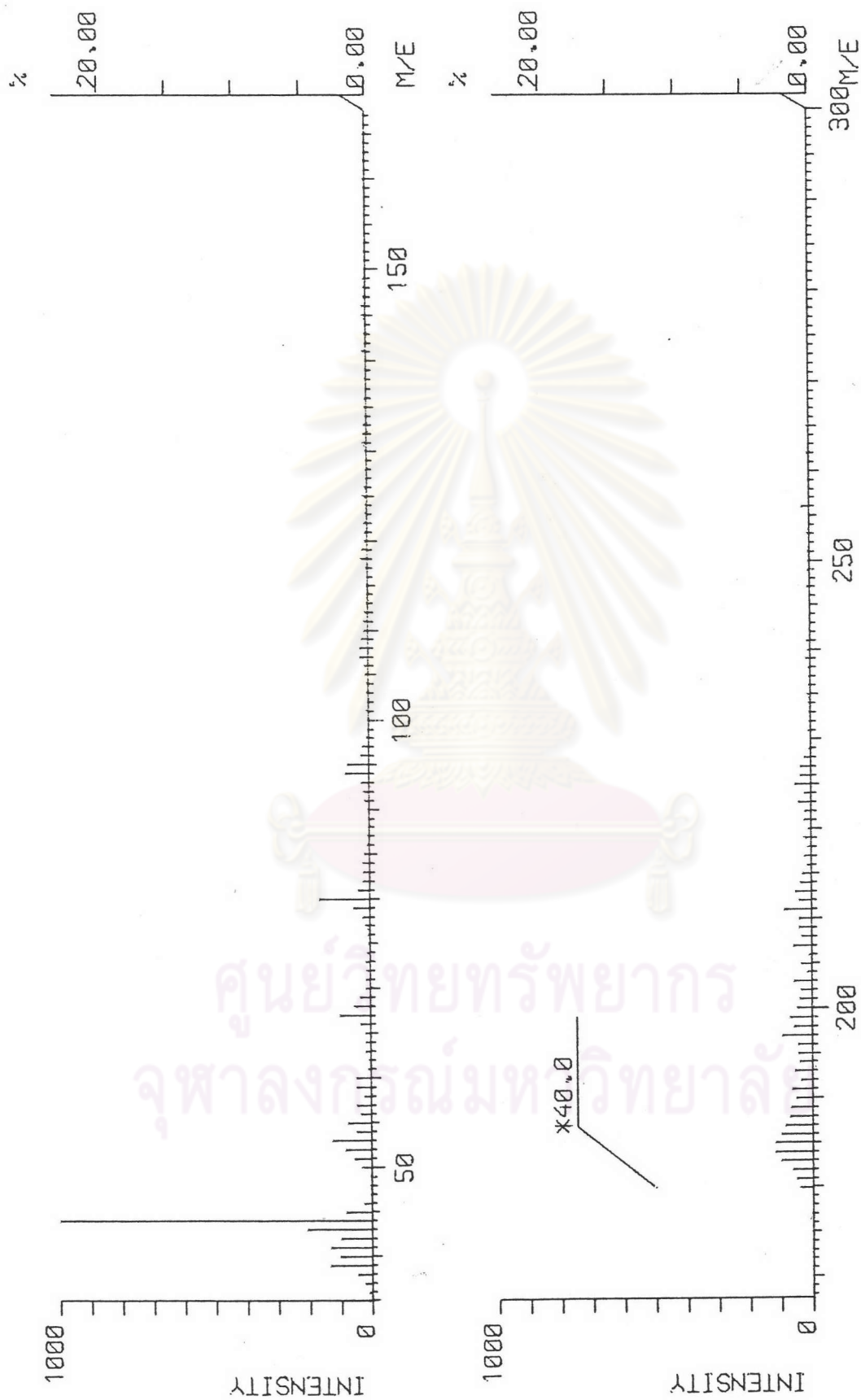


The electron impact spectrum of CTS3.5A.

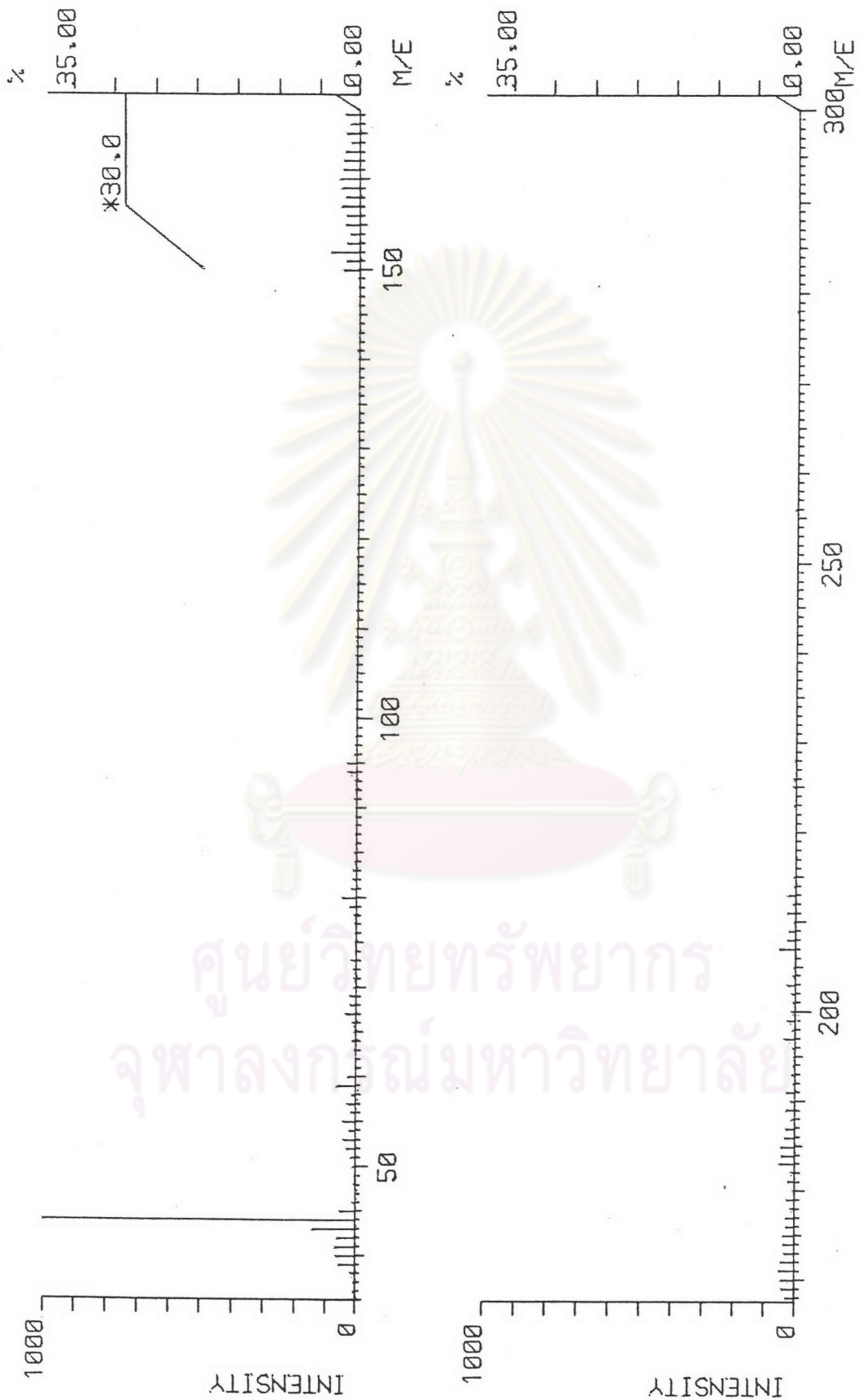




The electron impact spectrum of CTS7A.

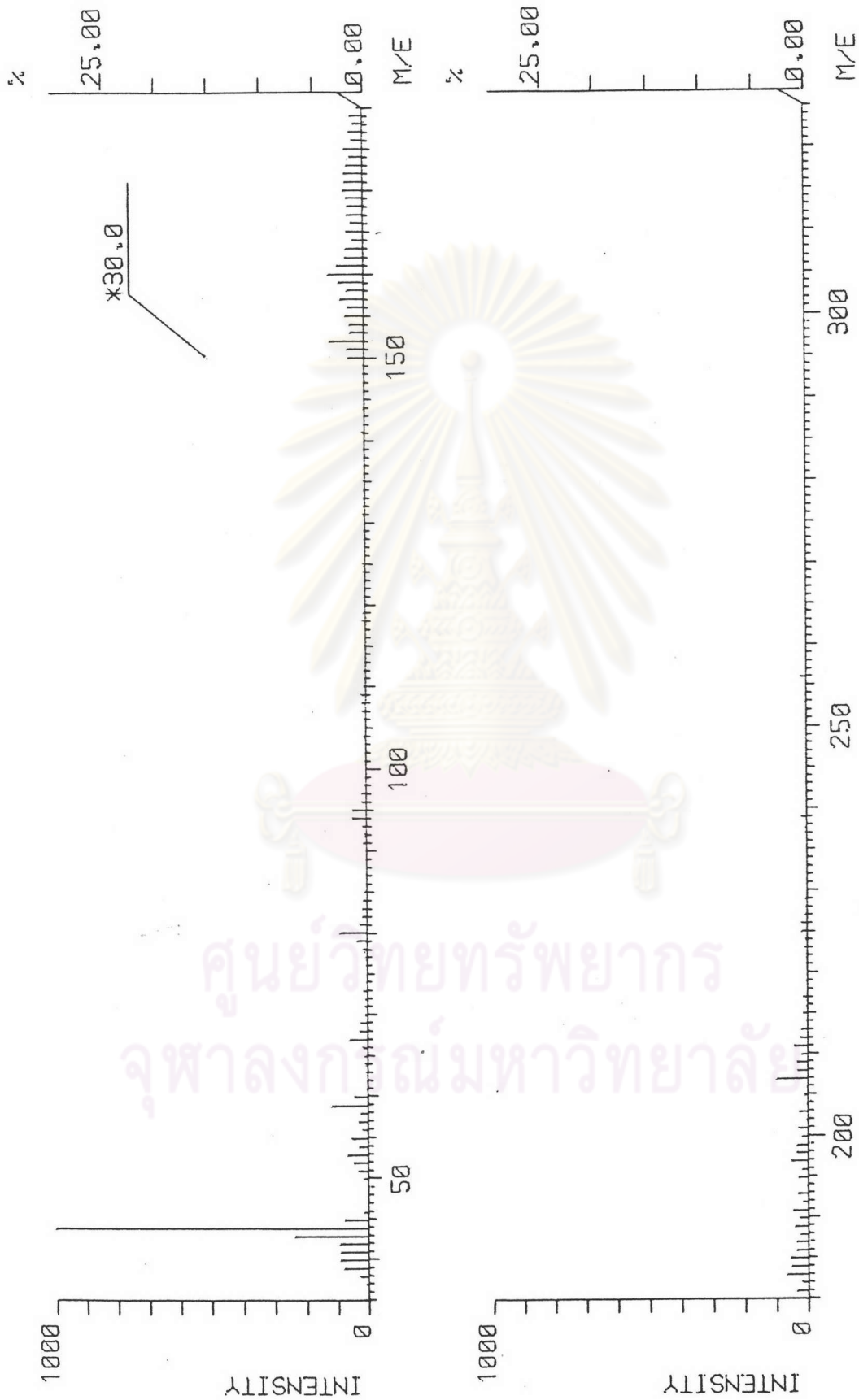


The electron impact spectrum of CTS73A.

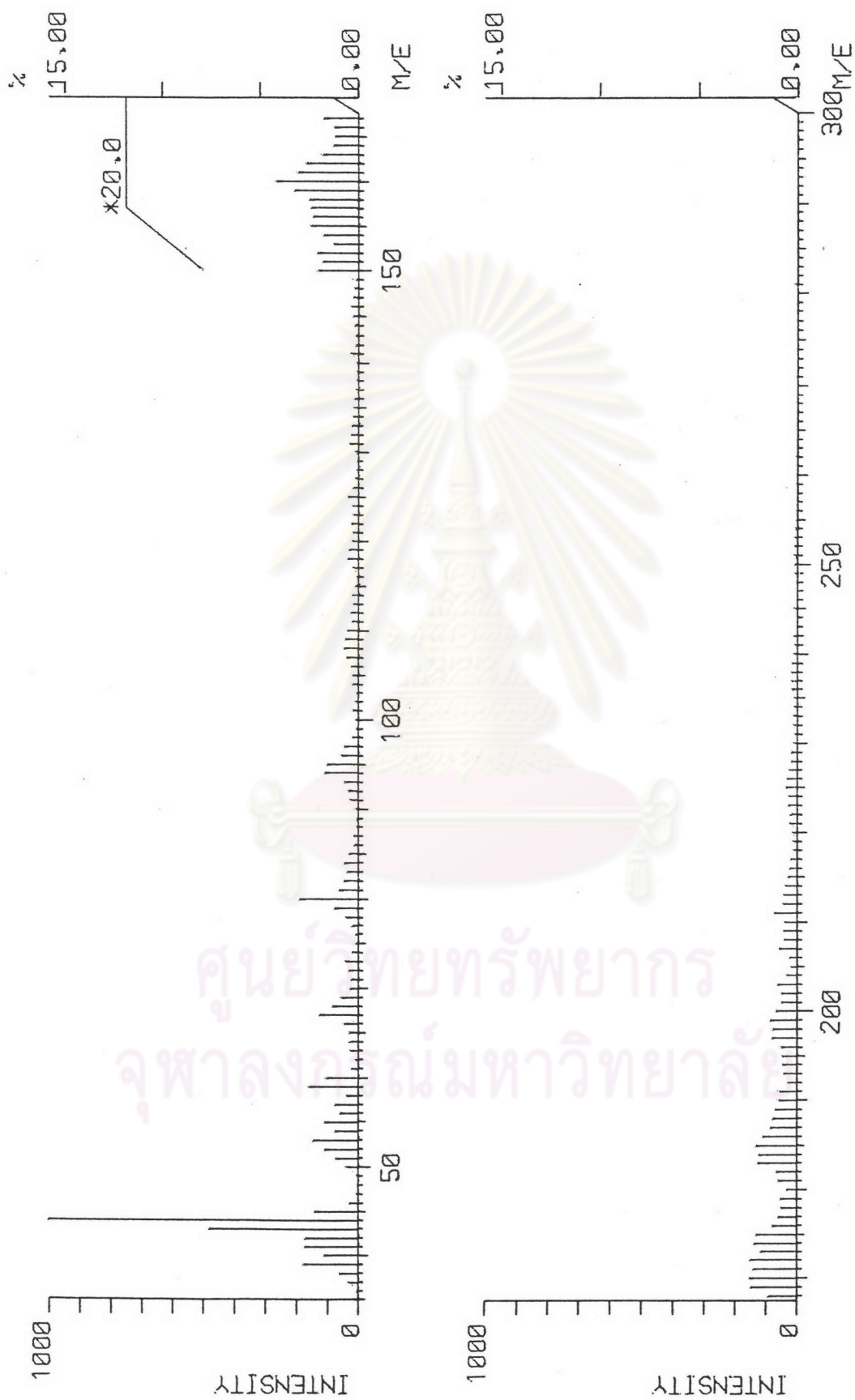


The electron impact spectrum of CTS2.5N





The electron impact spectrum of CTS3N



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The electron impact spectrum of CTS7N



The electron impact spectrum of CTS60N.

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## Appendix C

### True Density Determination

Solvent: Benzene (B) ,density = 2198 gm/ 2500 ml = 0.8792 gm/ml (a)

wt. of pycnometer (P) 10 ml = 8.8714 gm (b)

wt. of pycnometer + benzene = 17.7340 gm

wt. of benzene 10 ml = 8.8626 gm (c)

Disintegrant (D)	wt. of (gm)				wt. of B displaced	vol. of B displaced	True Density	mean (gm/ml)	s.d.
	P+D (d)	P+D+B (e)	D (f)=(d)-(b)	D+B (g)=(e)-(b)					
Chitin	(1)	9.3720	16.9292	0.5006	8.0578	1.3054	1.4848	0.3372	
	(2)	9.3780	16.9222	0.5066	8.0508	1.3184	1.4995	0.3378	0.3373
	(3)	9.3743	16.9248	0.5029	8.0534	1.3121	1.4924	0.3370	
CTS3A	(1)	9.3734	16.9321	0.5020	8.0607	1.3039	1.4831	0.3385	
	(2)	9.3734	16.9319	0.5020	8.0605	1.3041	1.4833	0.3384	0.3380
	(3)	9.3721	16.9284	0.5007	8.0570	1.3063	1.4858	0.3370	
CTS3.5A	(1)	9.3743	16.9500	0.5029	8.0786	1.2869	1.4637	0.3436	
	(2)	9.3745	16.9400	0.5031	8.0686	1.2971	1.4753	0.3410	0.3419
	(3)	9.3758	16.9384	0.5044	8.0670	1.3000	1.4786	0.3411	
CTS7A	(1)	9.3715	16.9490	0.5001	8.0776	1.2851	1.4617	0.3421	
	(2)	9.3713	16.9245	0.4999	8.0531	1.3094	1.4893	0.3357	0.3381
	(3)	9.3723	16.9260	0.5009	8.0546	1.3089	1.4887	0.3365	
CTS73A	(1)	9.3717	16.9308	0.5003	8.0594	1.3035	1.4826	0.3374	
	(2)	9.3741	16.9244	0.5027	8.0530	1.3123	1.4926	0.3368	0.3377
	(3)	9.3765	16.9280	0.5051	8.0566	1.3111	1.4912	0.3387	
CTS2.5N	(1)	9.3737	16.9258	0.5023	8.0544	1.3105	1.4906	0.3370	
	(2)	9.3725	16.9247	0.5011	8.0533	1.3104	1.4904	0.3362	0.3364
	(3)	9.3768	16.9175	0.5054	8.0461	1.3219	1.5035	0.3361	
CTS3N	(1)	9.3718	16.9113	0.5004	8.0399	1.3231	1.5049	0.3325	
	(2)	9.3754	16.9078	0.5040	8.0364	1.3302	1.5130	0.3331	0.3328
	(3)	9.3743	16.9078	0.5029	8.0364	1.3291	1.5117	0.3327	
CTS7N	(1)	9.3743	16.9305	0.5029	8.0591	1.3064	1.4859	0.3384	
	(2)	9.3724	16.9302	0.5010	8.0588	1.3048	1.4841	0.3378	0.3378
	(3)	9.3746	16.9253	0.5032	8.0539	1.3119	1.4922	0.3372	
CTS60N	(1)	9.3781	16.9242	0.5067	8.0528	1.3165	1.4974	0.3384	
	(2)	9.3721	16.9137	0.5007	8.0423	1.3210	1.5025	0.3332	0.3354
	(3)	9.3756	16.9127	0.5042	8.0413	1.3255	1.5076	0.3344	

**Appendix D****Hydration Capacity**

<b>Polymer</b>	<b>Hydration capacity</b>
Chitin	7.41 ± 0.03
CTS3A	6.27 ± 0.09
CTS3.5A	6.58 ± 0.08
CTS7A	6.46 ± 0.04
CTS73A	6.42 ± 0.10
CTS2.5N	6.40 ± 0.06
CTS3N	6.46 ± 0.06
CTS7N	6.64 ± 0.15
CTS60N	7.95 ± 0.08

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## Appendix E

### Swelling Power of Particle

Polymer	Bulk volume (cm <sup>3</sup> )	Swelling volume (cm <sup>3</sup> )	Swelling capacity (cm <sup>3</sup> )
<b>Chitin</b>	3.27 ± 0.25	5.52 ± 0.02	1.70 ± 0.12
<b>CTS3A</b>	3.00 ± 0.00	4.97 ± 0.05	1.66 ± 0.02
<b>CTS3.5A</b>	3.00 ± 0.00	4.98 ± 0.02	1.66 ± 0.01
<b>CTS7A</b>	2.87 ± 0.05	4.77 ± 0.02	1.66 ± 0.04
<b>CTS73A</b>	2.93 ± 0.05	4.83 ± 0.05	1.65 ± 0.01
<b>CTS2.5N</b>	2.90 ± 0.05	4.73 ± 0.05	1.63 ± 0.05
<b>CTS3N</b>	2.93 ± 0.09	4.95 ± 0.04	1.69 ± 0.06
<b>CTS7N</b>	3.10 ± 0.08	4.93 ± 0.02	1.59 ± 0.04
<b>CTS60N</b>	2.00 ± 0.00	5.73 ± 0.09	2.87 ± 0.05

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## Appendix F

### Water Uptake

Volume of water uptake of chitin and chitosans at various time intervals.

Time (min)	Volume of water uptake (ml) at various time intervals								
	Cthitin	CTS3A	CTS3.5A	CTS7A	CTS73A	CTS2.5N	CTS3N	CTS7N	CTS80N
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.25	0.87	0.47	0.44	0.49	0.45	0.34	0.36	0.37	0.09
0.50	1.51	0.85	0.83	0.85	0.86	0.62	0.66	0.69	0.17
0.75	1.92	1.19	1.18	1.23	1.26	0.89	0.94	0.98	0.24
1.00	2.05	1.50	1.49	1.59	1.61	1.12	1.21	1.28	0.31
1.50	2.09	2.05	2.05	2.05	2.04	1.61	1.67	1.73	0.50
2.00	2.11	2.19	2.13	2.09	2.08	2.03	2.14	2.11	0.68
2.50	2.12	2.20	2.14	2.09	2.08	2.21	2.22	2.16	0.83
3.00	2.12	2.20	2.15	2.09	2.08	2.22	2.23	2.16	0.99
3.50	2.13	2.21	2.15	2.10	2.09	2.23	2.23	2.16	1.15
4.00	2.14	2.21	2.15	2.10	2.09	2.23	2.24	2.17	1.24
5.00	2.16	2.22	2.16	2.11	2.09	2.24	2.24	2.18	1.49
10.00	2.16	2.23	2.18	2.12	2.12	2.26	2.27	2.20	2.06
15.00	2.17	2.24	2.19	2.14	2.14	2.28	2.29	2.22	2.38
20.00	2.17	2.24	2.20	2.15	2.15	2.29	2.30	2.24	2.56
25.00	-	-	-	-	-	-	-	-	2.67
30.00	-	-	-	-	-	-	-	-	2.72

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Rate of water uptake of chitin and chitosans at various time intervals.

Time (min)	Rate of water uptake (ml/min) at various time intervals								
	Chitin	CTS3A	CTS3.5A	CTS7A	CTS73A	CTS2.5N	CTS3N	CTS7N	CTS60N
0.25	3.47	1.87	1.75	1.96	1.79	1.37	1.44	1.47	0.36
0.50	2.56	1.53	1.59	1.44	1.65	1.09	1.19	1.29	0.32
0.75	1.67	1.36	1.39	1.53	1.59	1.08	1.15	1.17	0.27
1.00	0.49	1.24	1.25	1.41	1.43	0.95	1.08	1.11	0.31
1.50	0.09	1.10	1.12	0.93	0.85	0.98	0.91	0.95	0.37
2.00	0.03	0.29	0.16	0.07	0.07	0.84	0.94	0.75	0.36
2.50	0.02	0.02	0.02	0.01	0.01	0.35	0.17	0.10	0.31
3.00	0.01	0.00	0.01	0.01	0.00	0.03	0.02	0.00	0.31
3.50	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.32
4.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.02	0.19
5.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.24
10.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.11
15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
25.00	-	-	-	-	-	-	-	-	0.02
30.00	-	-	-	-	-	-	-	-	0.01

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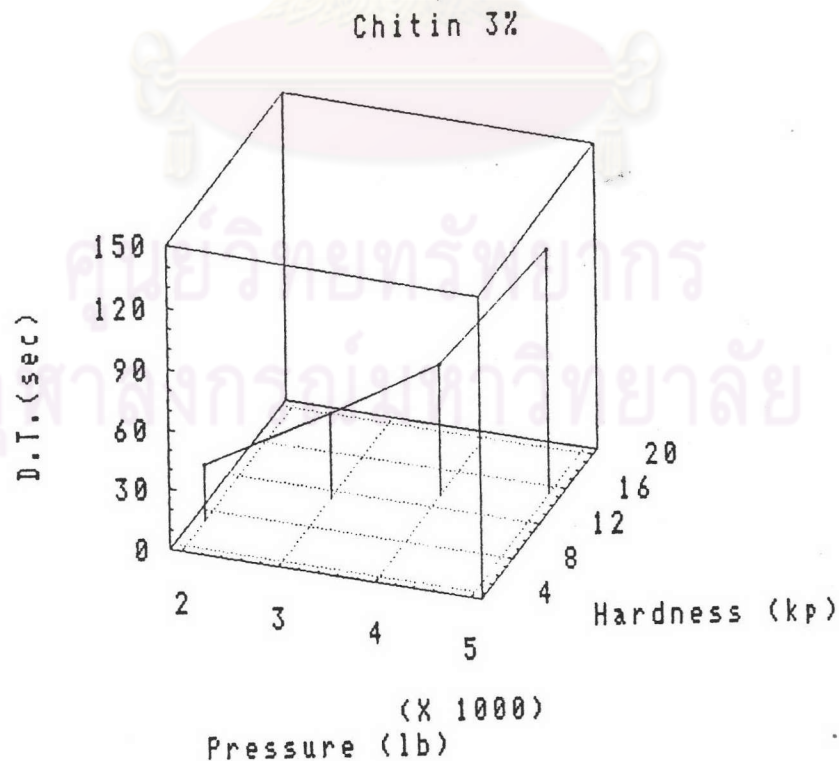
## Appendix G

### Paracetamol Tablet-Disintegration

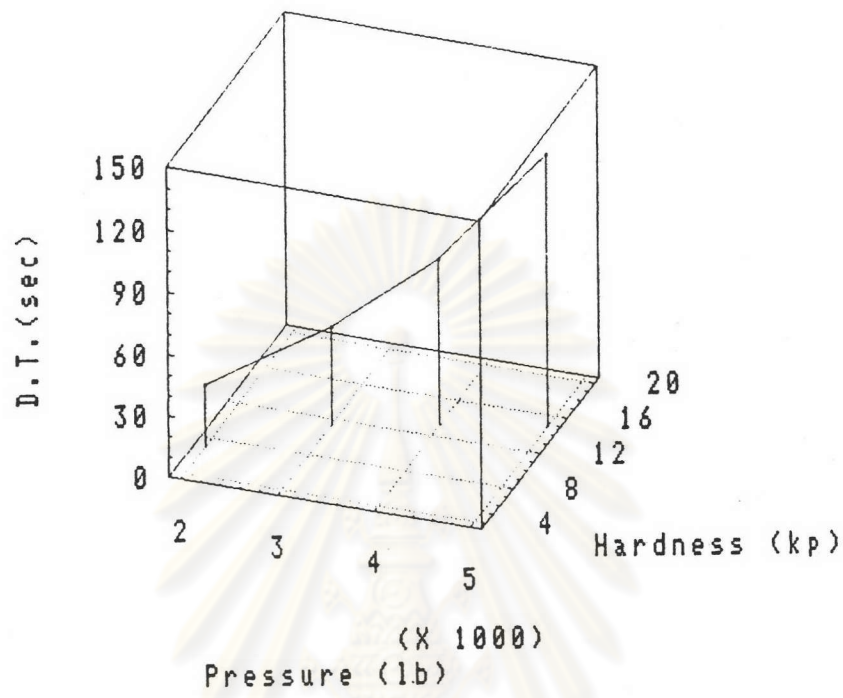
Disintegration time of various paracetamol tablets having 3, 5, and 7 % disintegrant and tableting by using compression-pressure 2000, 3000, 4000, and 5000 lb. were evaluated. The results are depicted in three axis-graphs: Pressure vs. Hardness vs. Disintegration time, as follows.

#### Disintegrant 3 %

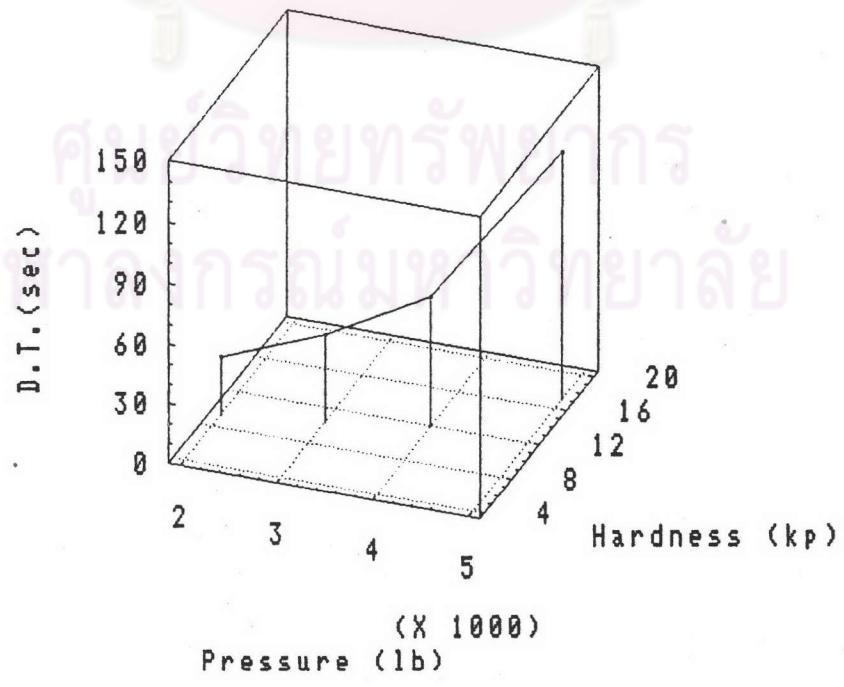
Disintegration medium: deionized water  $37 \pm 2^\circ\text{C}$



CTS3A 3%

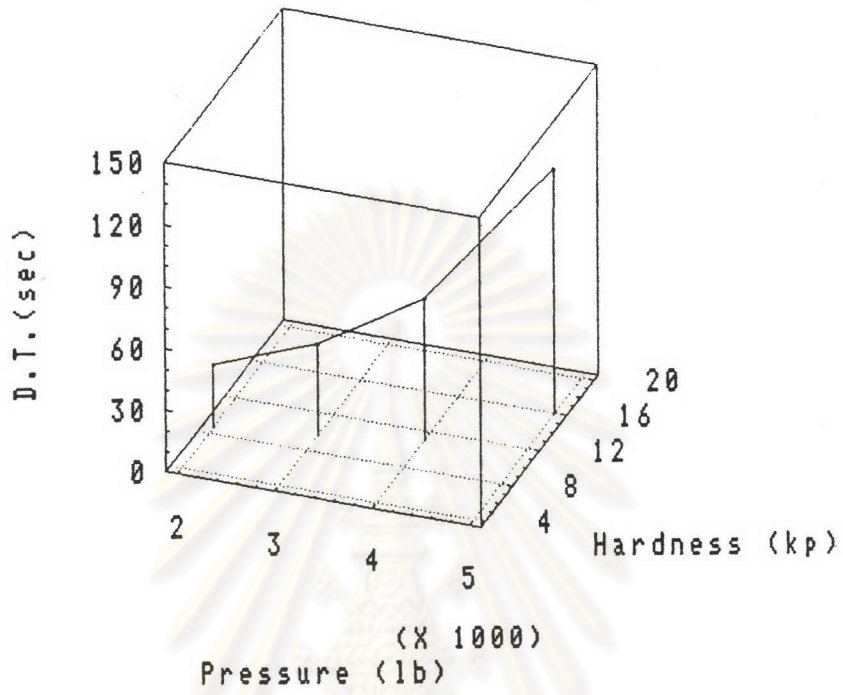


CTS3.5A 3%

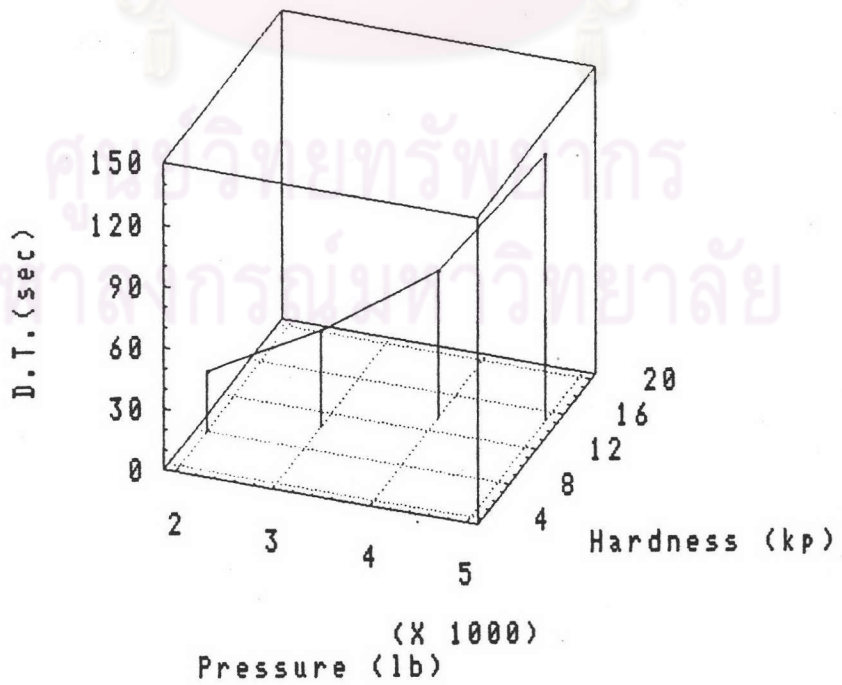


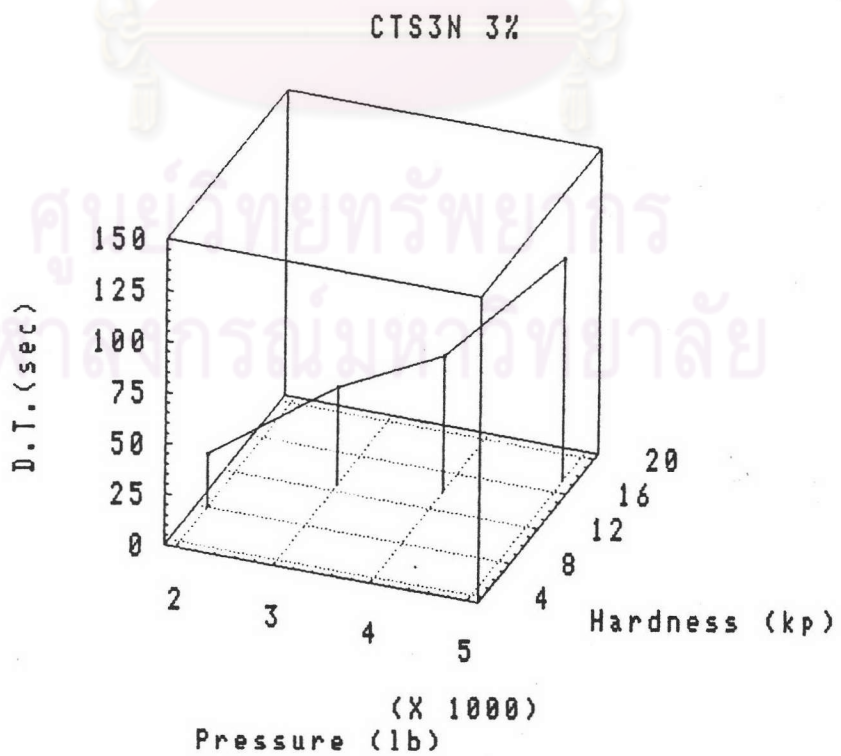
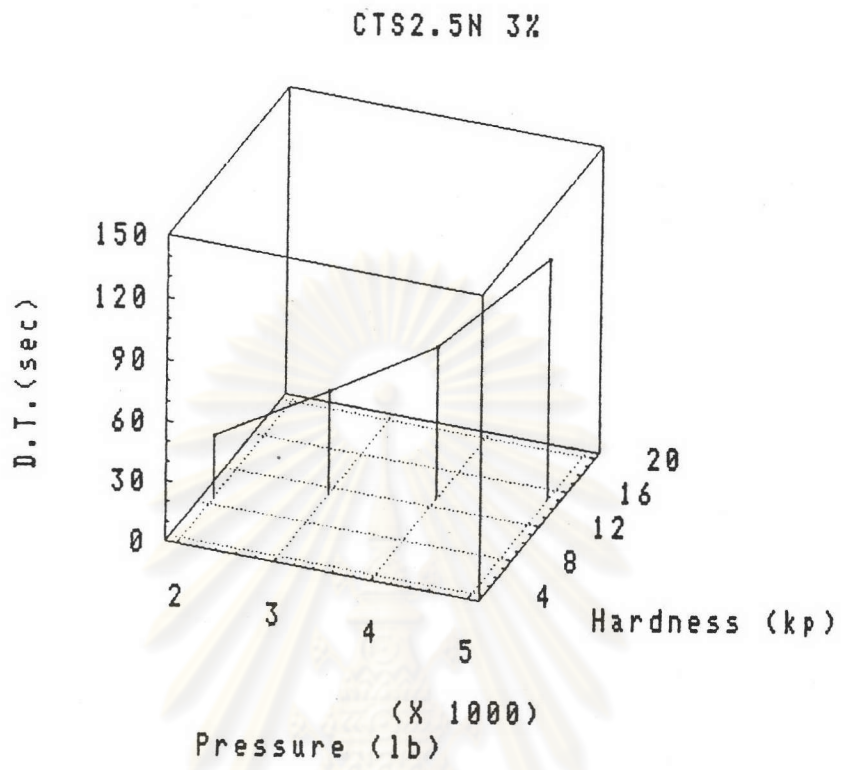


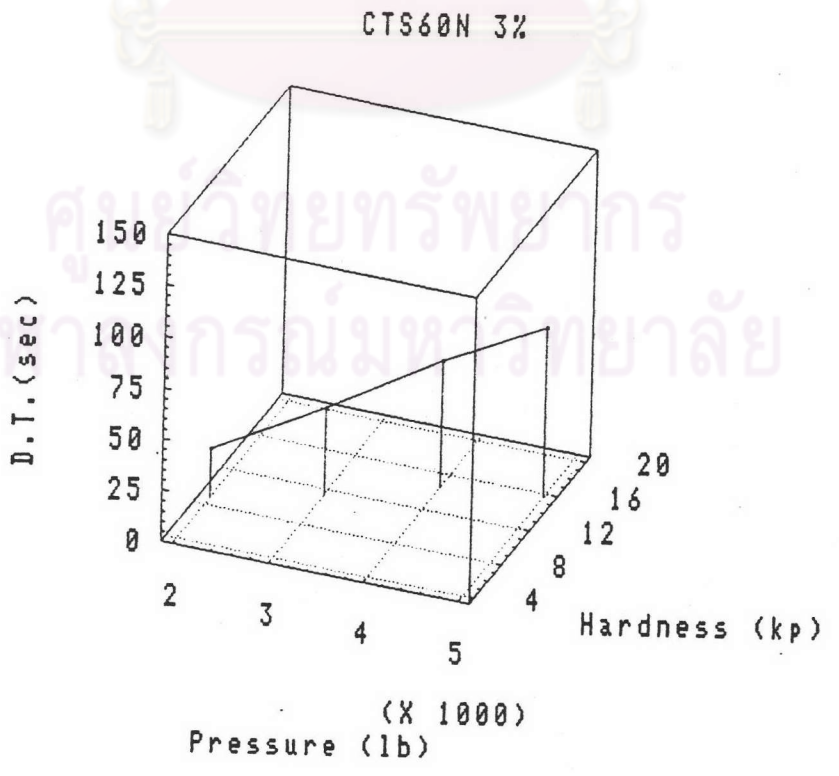
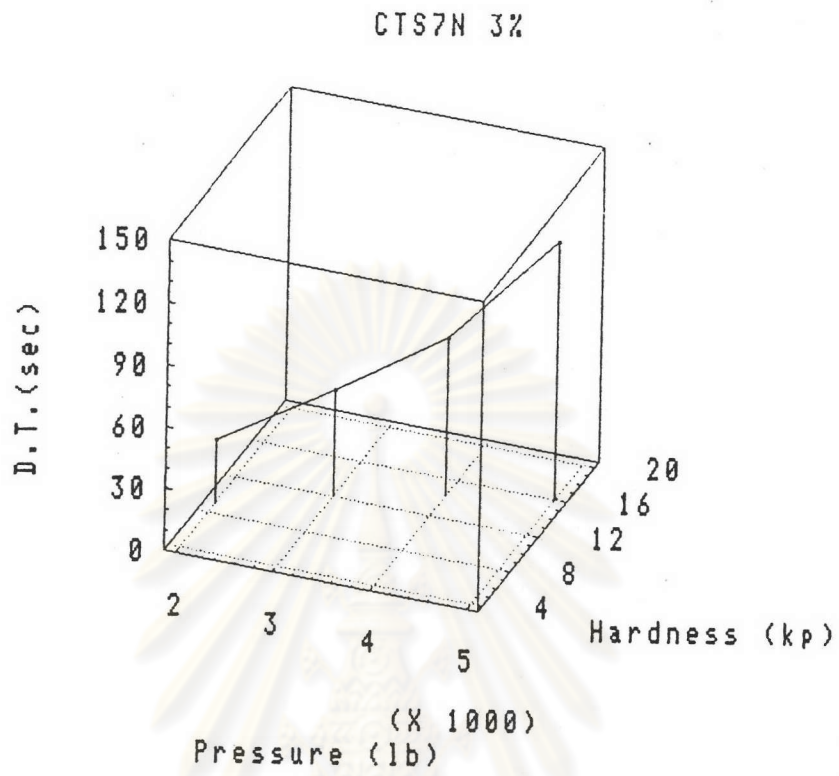
CTS7A 3%



CTS73A 3%



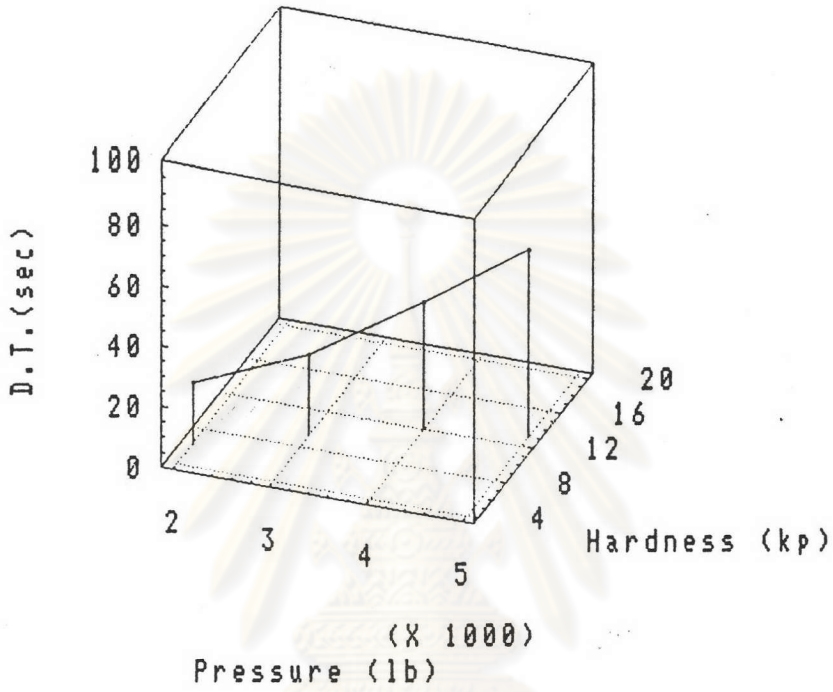




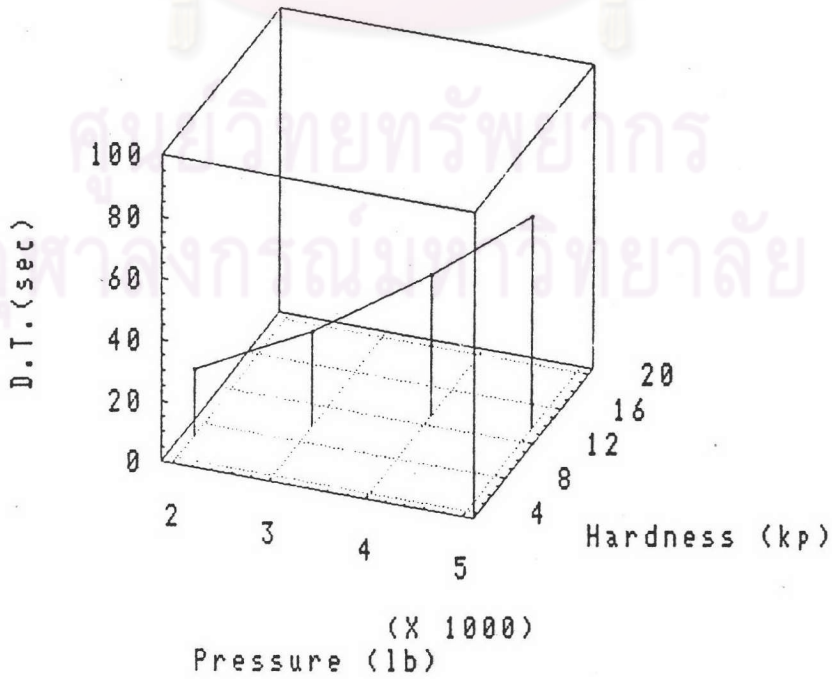
**Disintegrant 5 %**

**Disintegration medium: deionized water  $37 \pm 2^\circ\text{C}$**

**Chitin 5%**

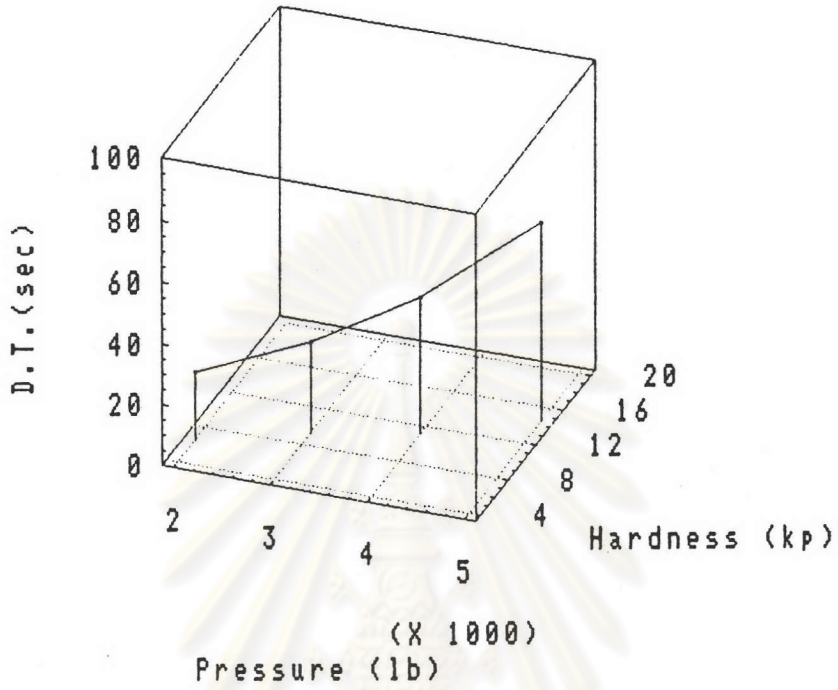


**CTS3A 5%**

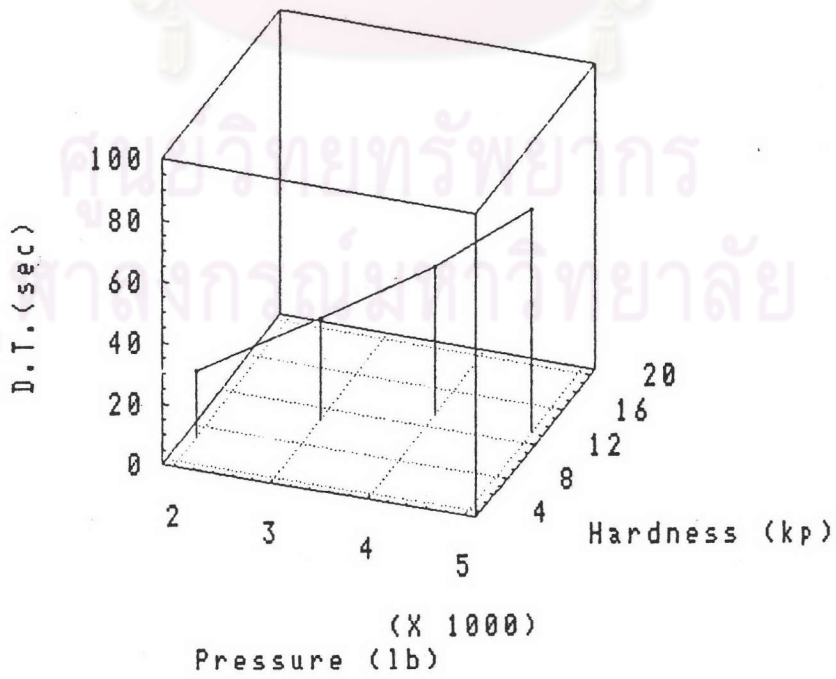




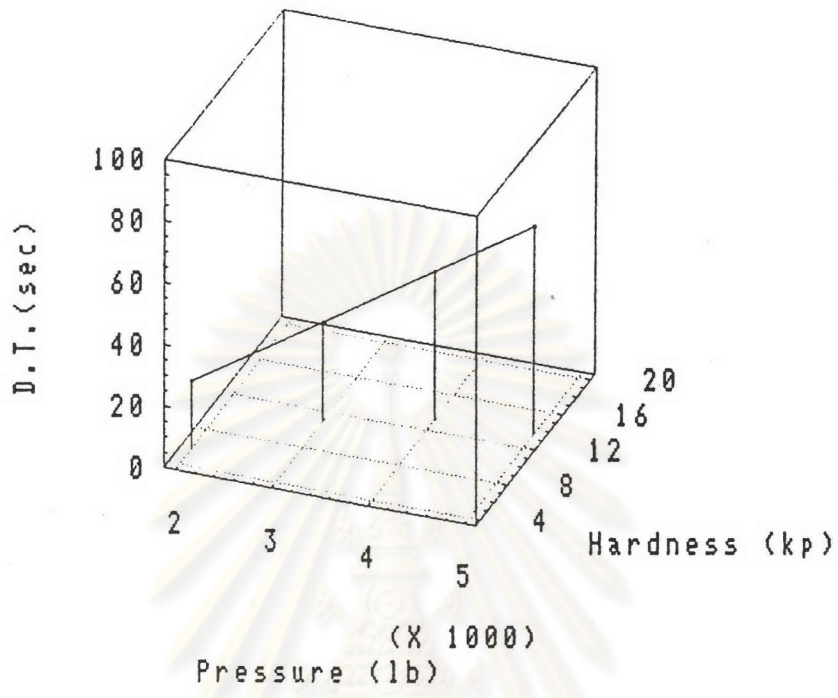
CTS3.5A 5%



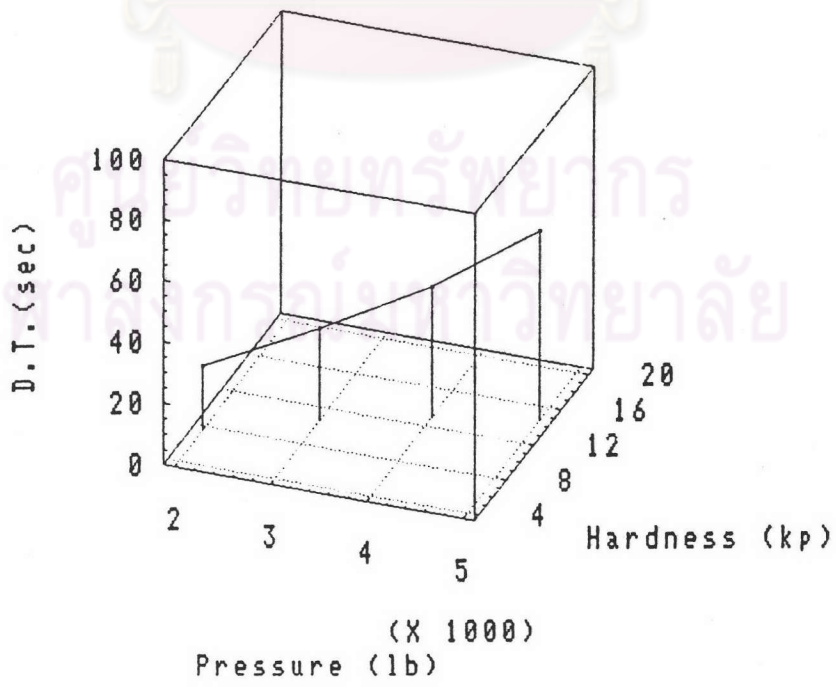
CTS7A 5%



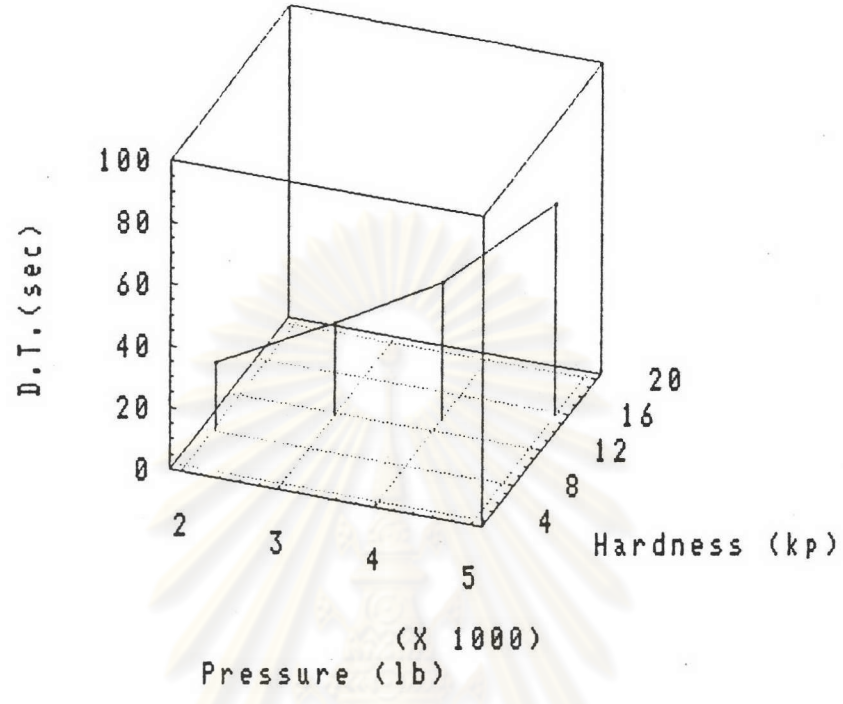
CTS73A 5%



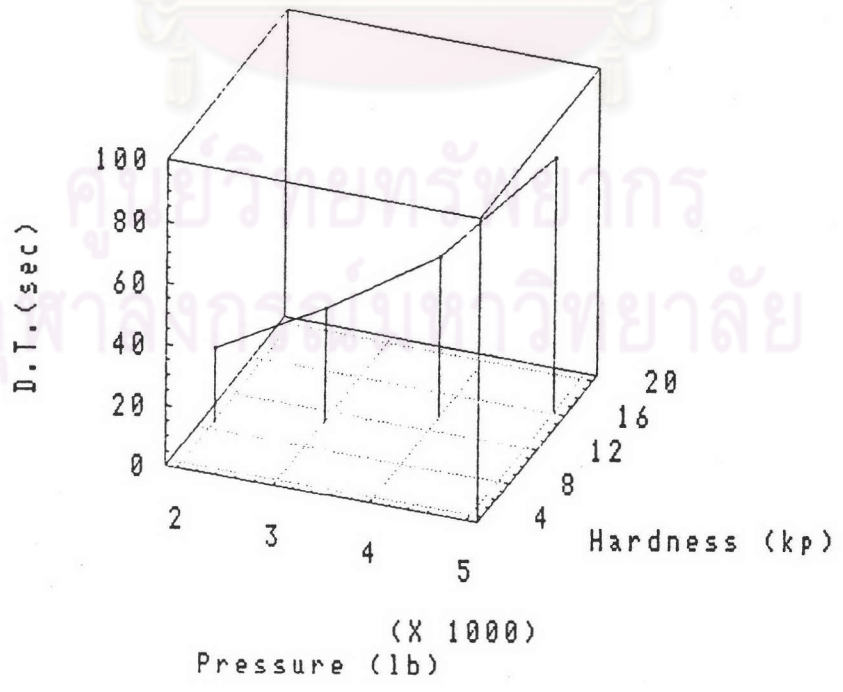
CTS2.5N 5%

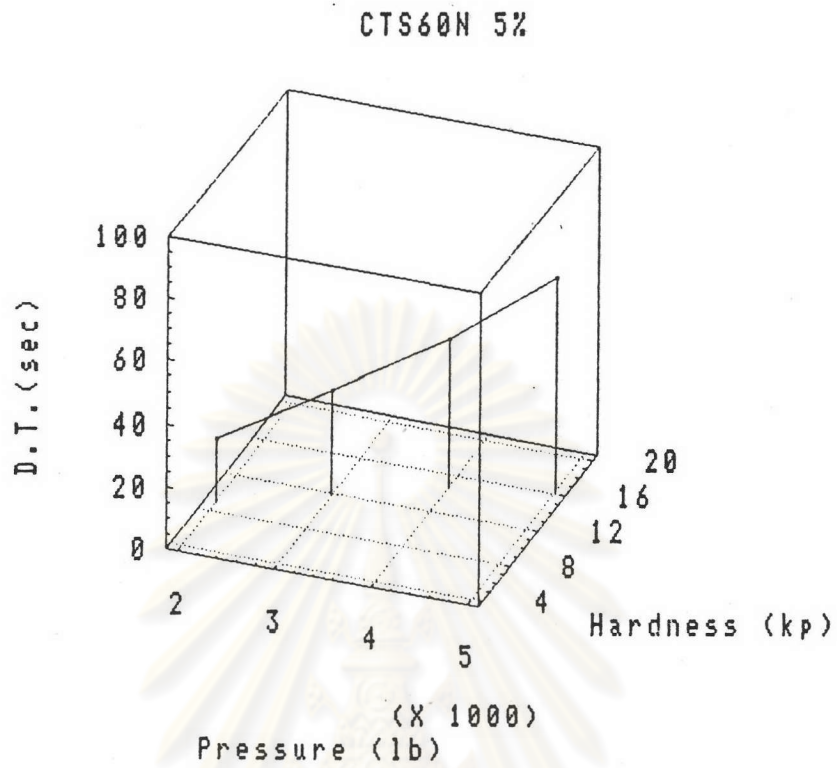


CTS3N 5%



CTS7N 5%



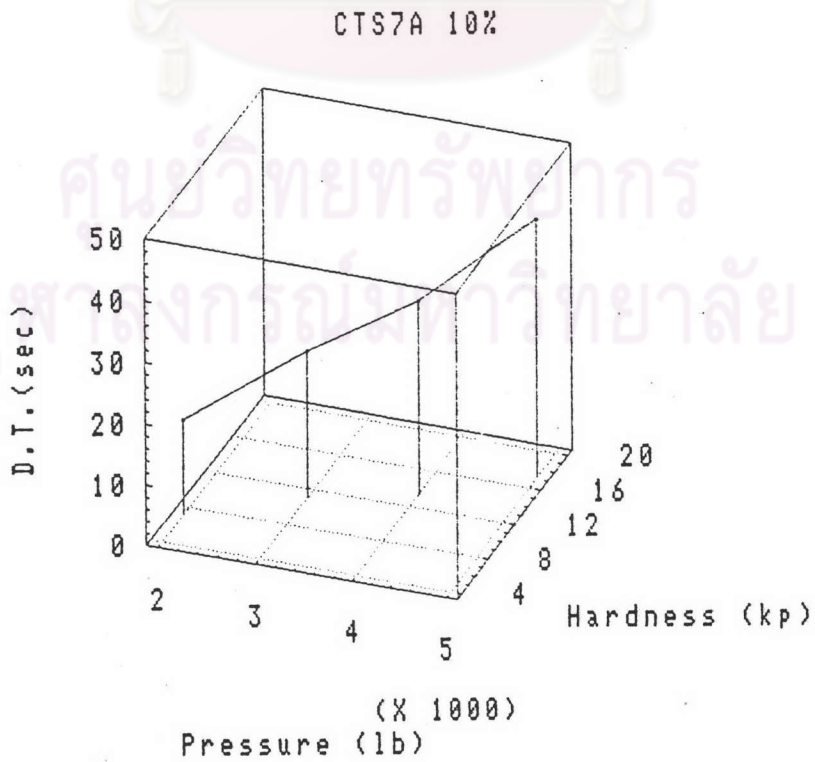
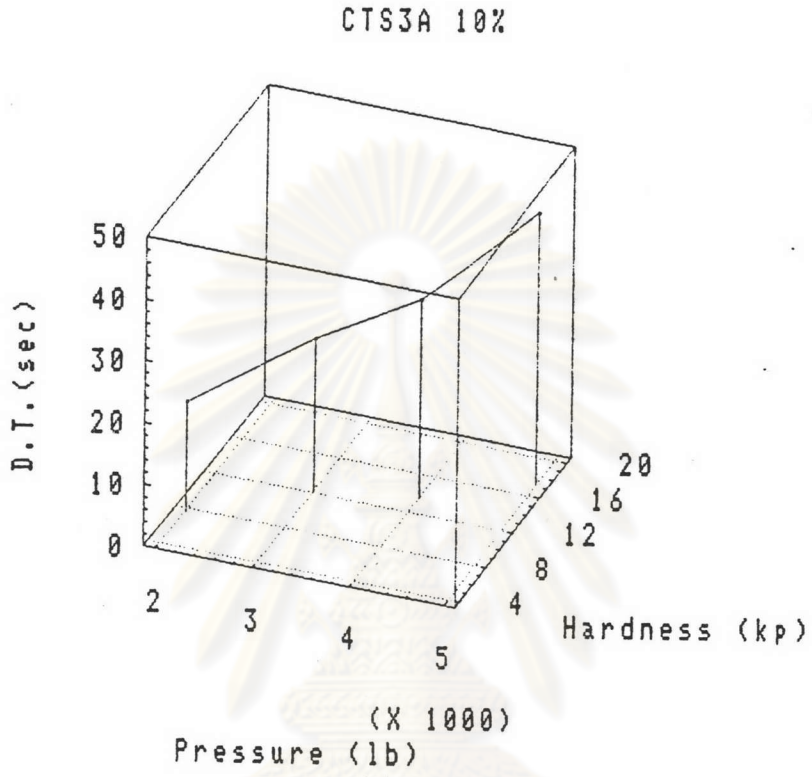


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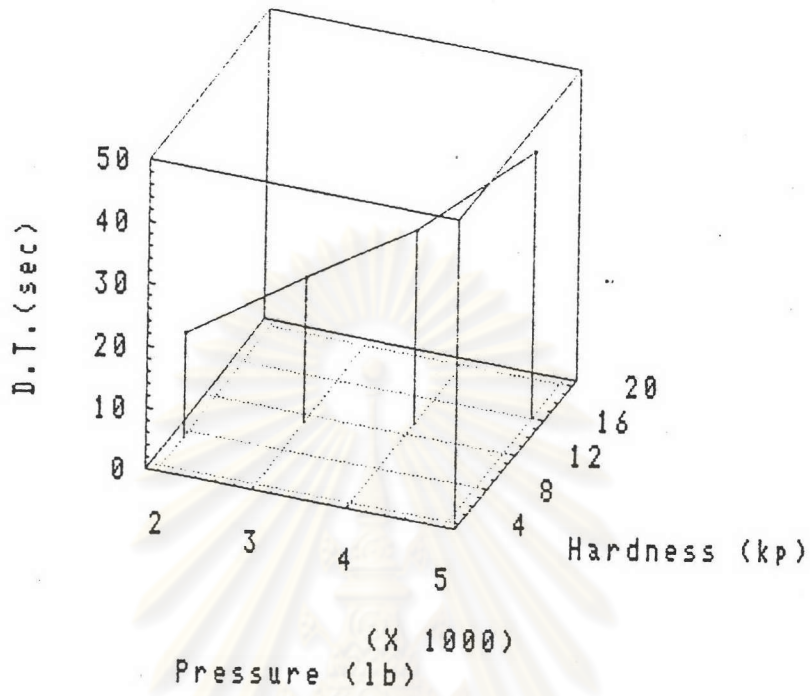


**Disintegrant 10 %**

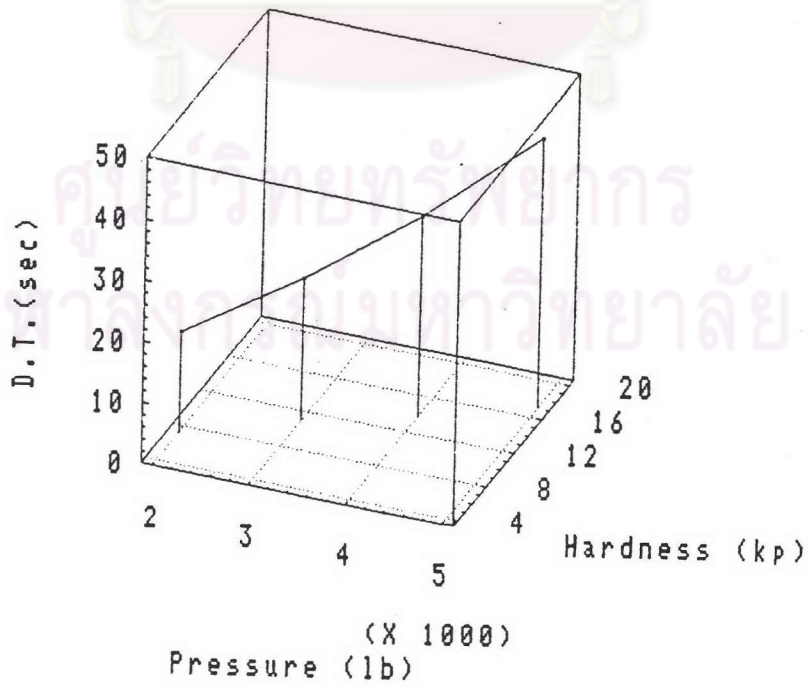
**Disintegration medium: deionized water  $37 \pm 2 \text{ }^\circ\text{C}$**



CTS2.5N 10%



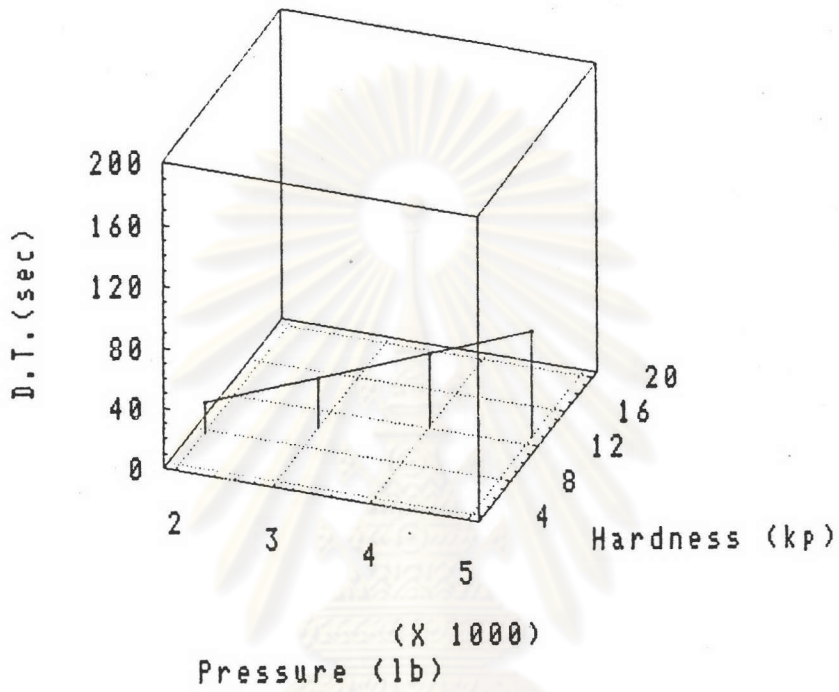
CTS7N 10%



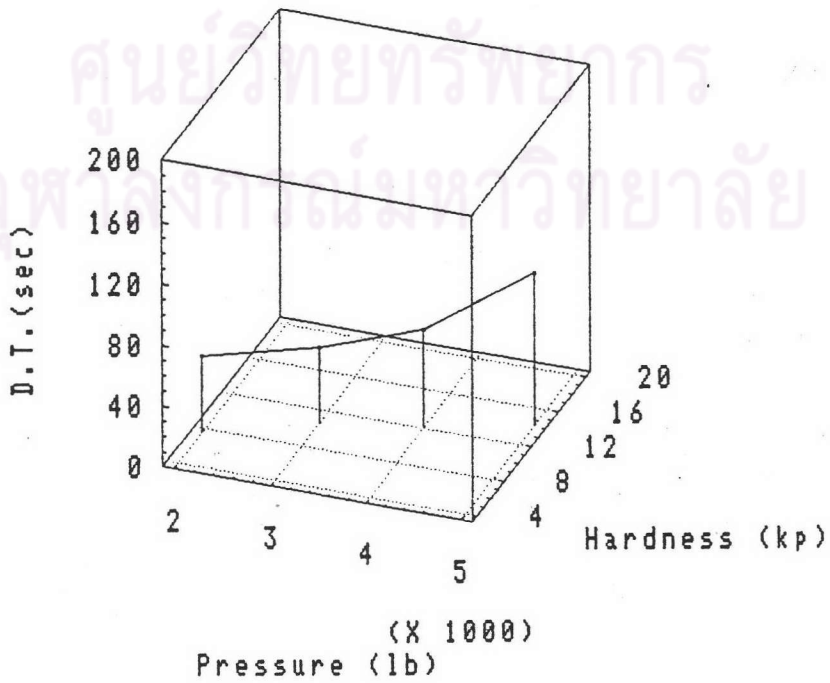
**Disintegrant 5 %**

**Disintegration medium: 0.1 N. HCl 37 ± 2 °C**

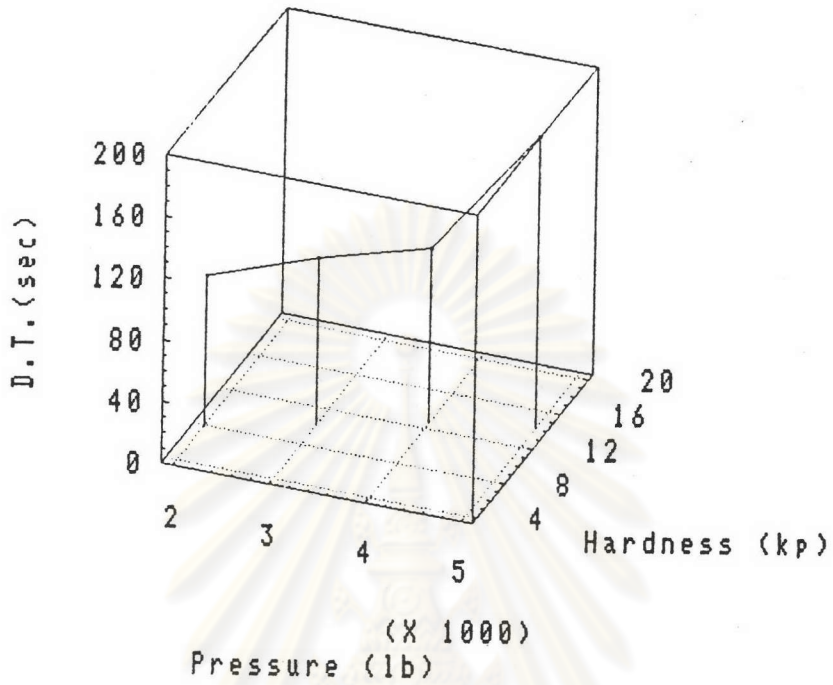
**Chitin 5%**



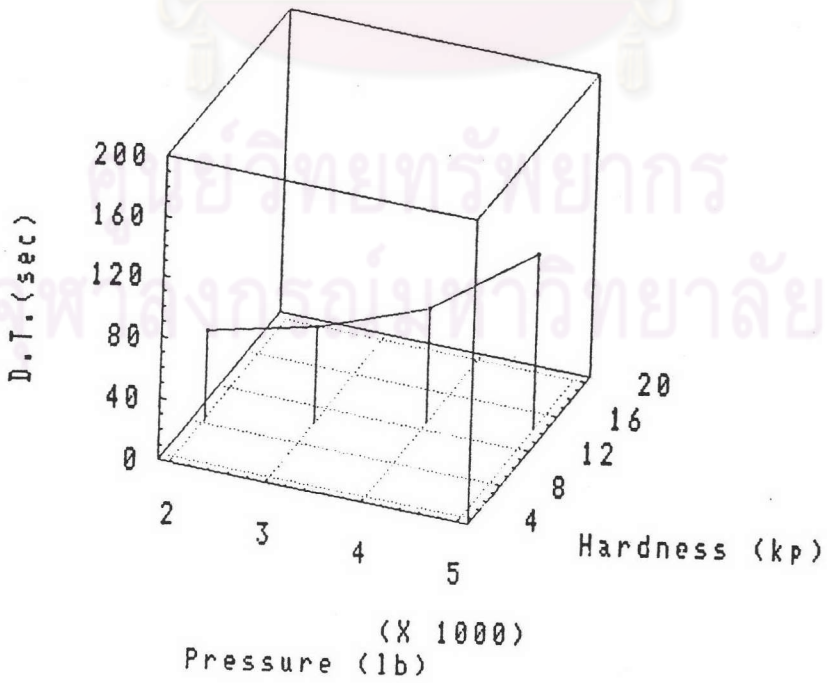
**CTS3A 5%**



CTS3.5A 5%

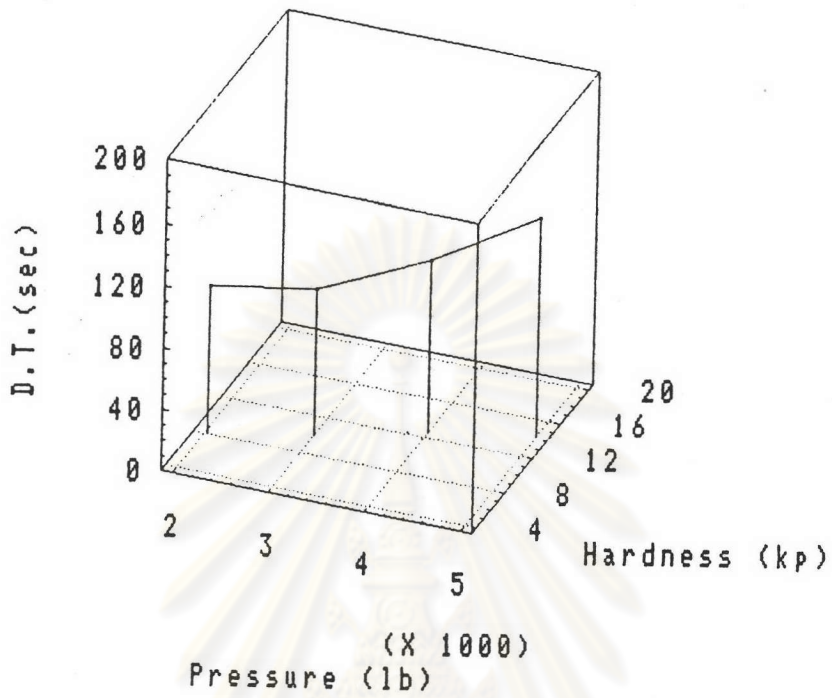


CTS2.5N 5%

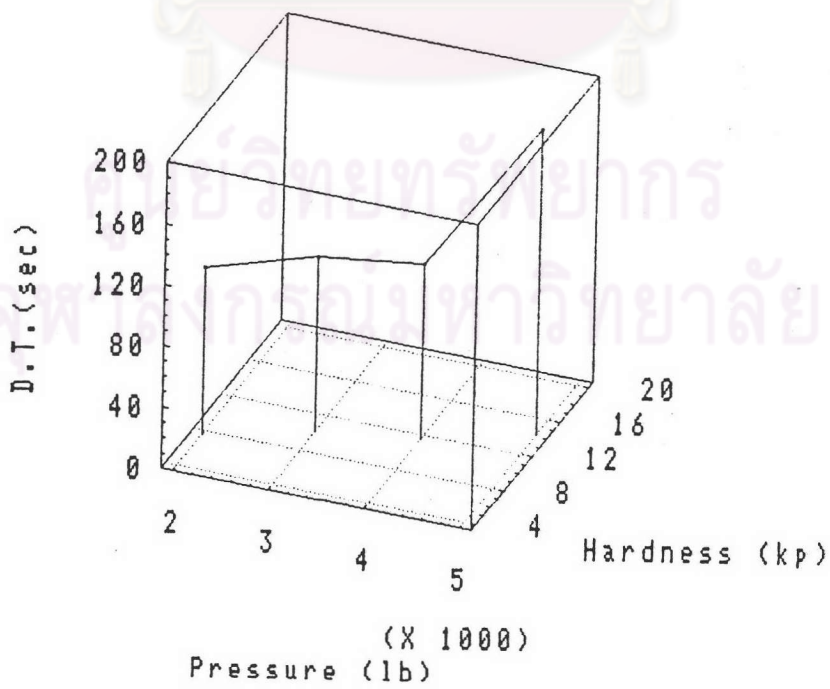




CTS3N 5%



CTS60N 5%



## Vitae

Miss. Siwaphorn Jaiyongka was born on December 18, 1965. She got her degree in Bachelor of Science in Pharmacy in 1989 from Faculty of Pharmaceutical Sciences, Chiang Mai University.



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