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APPENDICES

APPENDIX A

CALIBRATION CURVE

The concentrations versus absorbance of propranolol hydrochloride in methanol and in dilute hydrochloric (1:100) at 290 nm are presented in Table A1 and A2, respectively. The calibration curves obtained by regression analysis of these data are depicted in Figure A1 and A2, respectively.

Table A1 Concentration and absorbance data for calibration curve of the propranolol hydrochloride in methanol at 290 nm

Standard curve of propranolol hydrochlore in methanol at 290 nm						
Concentration (mcg/ml)	Absorbance			Ave.	SD	%CV
	n1	n2	n3			
10	0.2166	0.2237	0.2142	0.21817	0.00403	1.84880
20	0.428	0.4289	0.4231	0.42667	0.00255	0.59734
30	0.6354	0.633	0.6294	0.63260	0.00247	0.38978
40	0.8451	0.8421	0.8422	0.84313	0.00139	0.16501
50	1.0567	1.0498	1.0523	1.05293	0.00285	0.27089

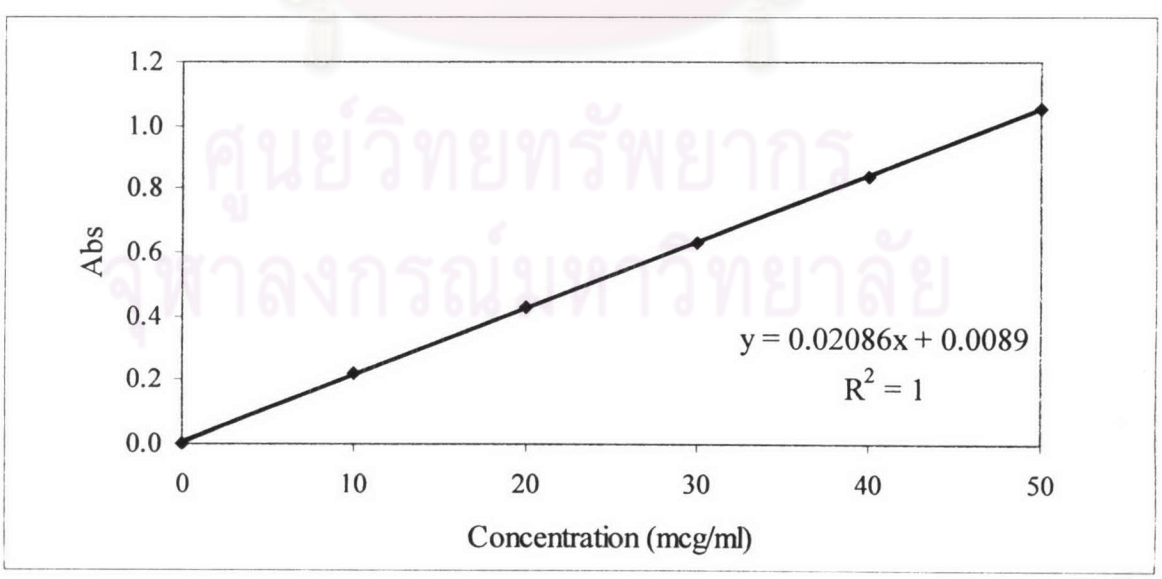


Figure A1 Calibration curve for the propranolol hydrochloride in methanol using absorption spectroscopy at 290 nm

Table A2 Concentration and absorbance data for calibration curve of the propranolol hydrochloride in dilute hydrochloric (1:100) at 290 nm

Standard curve of propranolol hydrochlore in dilute hydrochloric (1:100) at 290 nm						
Concentration (mcg/ml)	Absorbance			Ave.	SD	%CV
	n1	n2	n3			
10	0.1981	0.1978	0.1981	0.19800	0.00014	0.07142
20	0.3952	0.3963	0.3973	0.39627	0.00086	0.21643
30	0.5948	0.5952	0.5956	0.59520	0.00033	0.05487
40	0.7903	0.7952	0.7961	0.79387	0.00255	0.32104
50	0.9884	0.9926	0.9943	0.99177	0.00248	0.25003

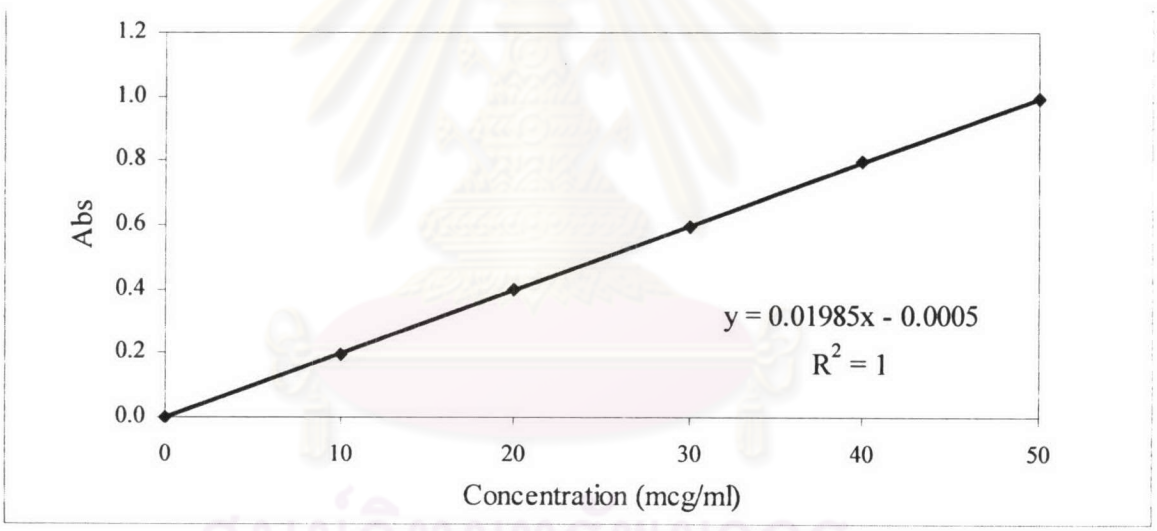


Figure A2 Calibration curve for the propranolol hydrochloride in dilute hydrochloric acid (1:100) using absorption spectroscopy at 290 nm

APPENDIX B

WEIGHT LOSS FROM PRE-HEATING

Table B1 Weight loss from pre-heating of core pellets

Core pellet (mesh cut)	Initial weight (gm)	Final weight (gm)			weight loss (gm)			Average weight loss (gm)	SD	%CV
		1	2	3	1	2	3			
14/16	250.00	247.38	246.87	246.95	2.62	3.13	3.05	**2.93**	0.27	9.35
16/18	250.00	247.07	246.12	246.84	2.93	3.88	3.16	**3.32**	0.50	14.91
18/20	250.00	246.93	246.54	247.19	3.07	3.46	2.81	**3.11**	0.33	10.51
Rx 23 low moisture	250.00	248.42	248.83	247.87	1.58	1.17	2.13	**1.63**	0.48	29.61
Rx 26 lowest moisture	250.00	249.23	248.97	248.89	0.77	1.03	1.11	**0.97**	0.18	18.33

APPENDIX C

The UV/visible spectrophotometry was used to determine the amount of propranolol hydrochloride at 290 nm, which was the λ_{max} of drug absorbances in methanol and dilute hydrochloric acid (1:100). The absorbance spectra in methanol and dilute hydrochloric acid (1:100) are displayed in **Figure C1 and C2.** Additionally, the main composition of coated pellets are polymer and core pellets may be absorbed UV light at the same wavelength of propranolol hydrochloride (290 nm). Hence, the blank pellets were coated with Eudragit® E PO and also determined at 290 nm by UV/visible spectrophotometry. The absorbance values of coated pellets in both media are shown in **Table C1 and C2** and absorbance characteristics of coated pellets in both media are shown in **Figures C3-C6.** It could be observed that the absorbance characteristics of blank pellets coated with Eudragit® E PO did not interfere in the drug absorbances.

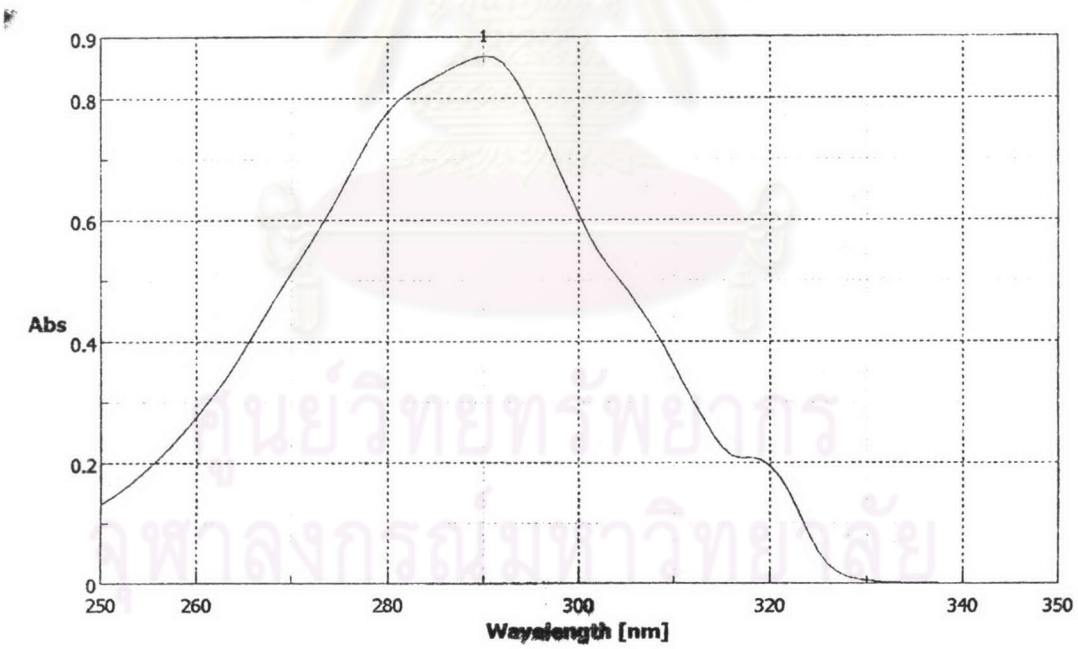


Figure C1 The sample scan of propranolol hydrochloride in methanol

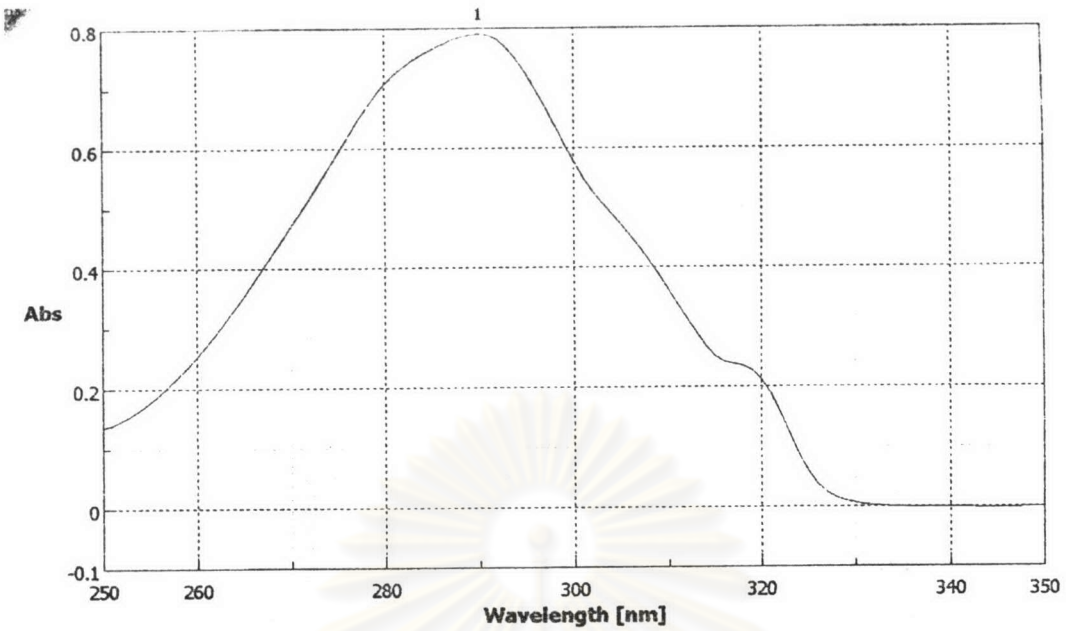


Figure C2 The sample scan of propranolol hydrochloride in dilute hydrochloric acid (1:100)

Table C1 The absorbance values of the main compositions of coated pellets in methanol at 290.0 nm.

Main composition	Sample 1	Sample 2	Sample 3	Ave.	SD	%CV
Core lactose	0.00092	0.00110	0.00074	0.00092	0.00018	19.56522
Coated core lactose with Eudragit® EPO	0.00065	0.00123	0.00140	0.00109	0.00039	35.96657

Table C2 The absorbance values of the main compositions of coated pellets in dilute hydrochloric acid (1:100) at 290.0 nm.

Main composition	Sample 1	Sample 2	Sample 3	Ave.	SD	%CV
Core lactose	0.00113	0.00070	0.00090	0.00091	0.00022	23.64553
Coated core lactose with Eudragit® EPO	0.0007	0.00078	0.00150	0.00099	0.00044	44.35627

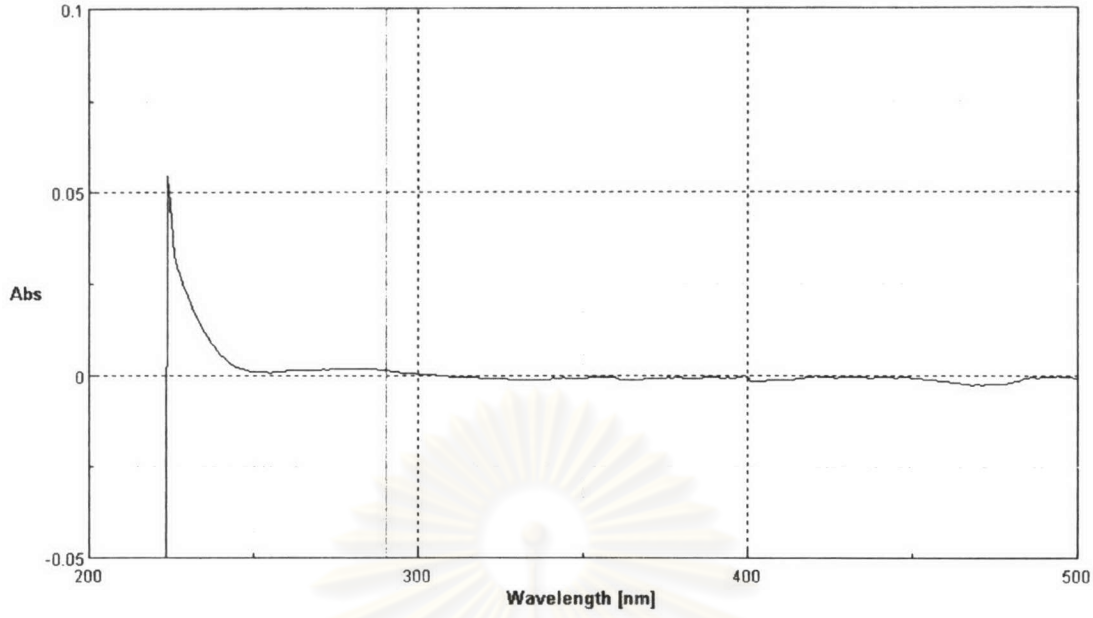


Figure C3 The sample scan of core lactose in methanol

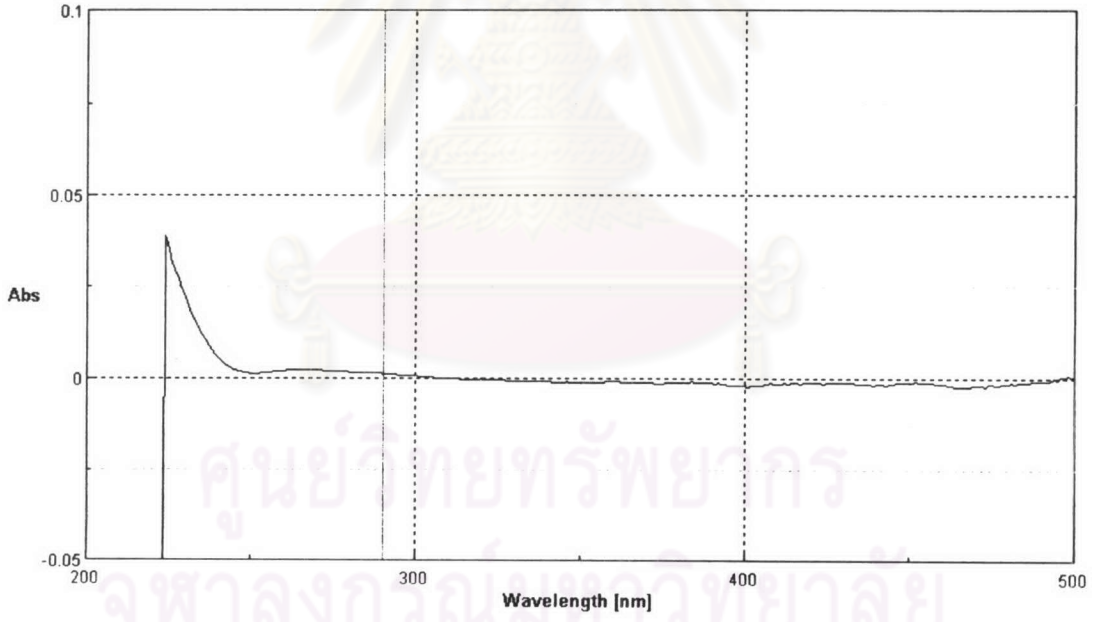


Figure C4 The sample scan of core lactose with Eudragit ®E PO in methanol

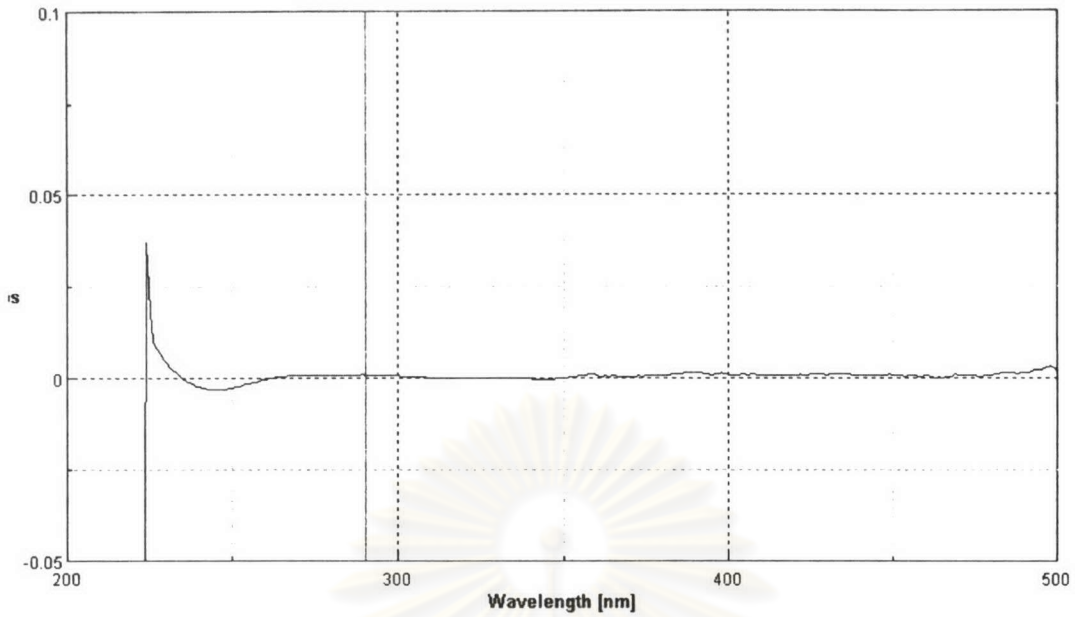


Figure C5 The sample scan of core lactose in dilute hydrochloric acid (1:100)

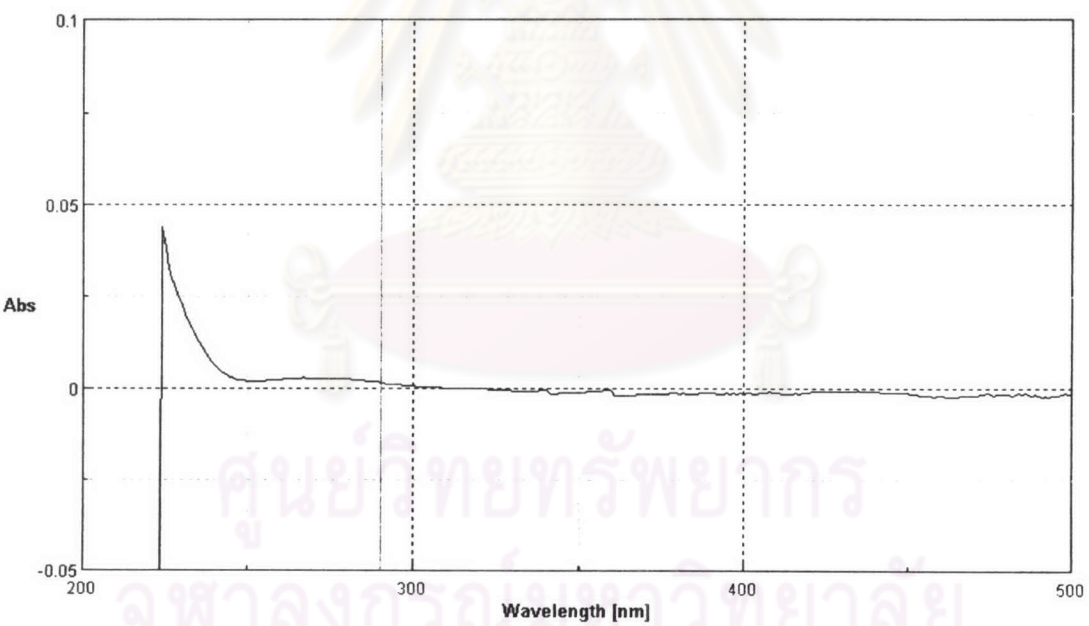


Figure C6 The sample scan of core lactose with Eudragit ®E PO in dilute hydrochloric acid (1:100)

APPENDIX D

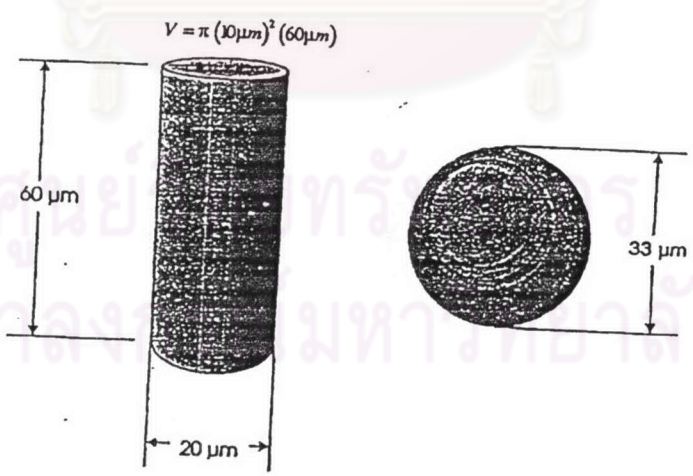
PARTICLE DISTRIBUTION OF EUDRAGIT® E

The particle size of Eudragit® E was determined by Mastersizer S. It is a range of light scattering based particle sizers (Mastersizer particle size analyzer, Instrument manual). The results reported by them are a number of fundamental concepts as follows:

- The result is volume based.
- The result is expressed in terms of equivalent spheres.
- The derivation of distribution parameters.

The first, this means that when the result lists, for example 11% of the distribution in the size category 6.97-7.75 microns this means that total volume of all particles with diameters in this range represents 11% of the total volume of all particles in the distribution. The result performed as the peak of frequency curve.

The second point is that the distribution is expressed in terms of the volumes of equivalent spheres. Consider a cylindrical particle of diameter 20 microns and length 60 microns. The volume of the cylinder is:



The sphere of equivalent volume would have a diameter center on:

$$\sqrt[3]{\frac{6V}{\pi}} = 33\mu m$$

With a spread from 20 to 60 microns.

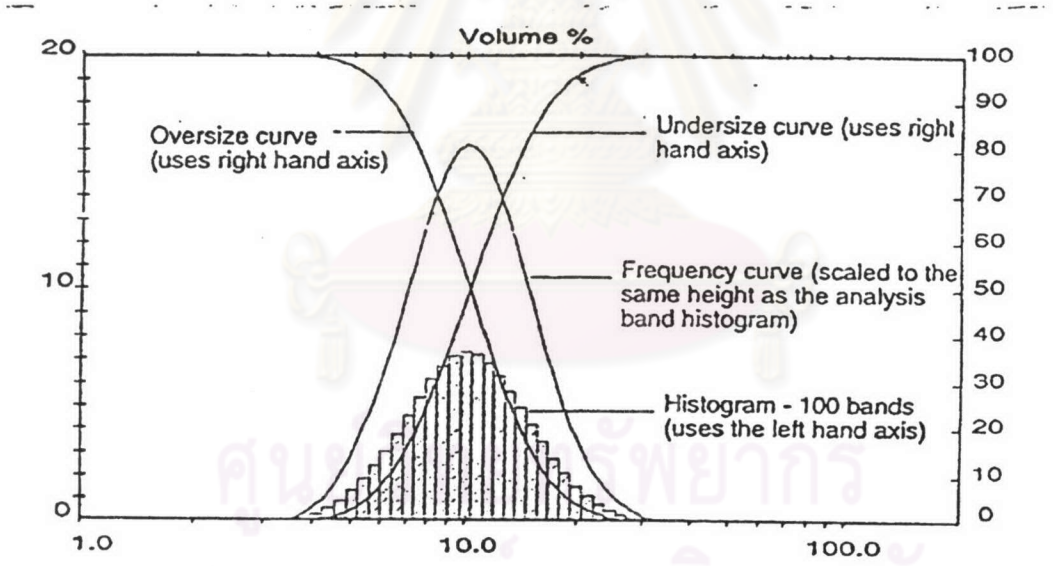
It is interesting to compare this with other techniques. Sieving would pass the particles through a 20 microns aperture and classify them as 20 microns. Sedimentation would give a result related to the total surface area, in this case reporting a diameter of around 40 microns.

If wishing to correlate laser diffraction results with values from some other techniques, it might consider applying shape correction using the result modification procedure built into the Malvern program.

The third point is that the analyzed distribution is a set of size classes, which the representative diameter for each class is taken to be the geometric men of the size band limits:

The frequency curve is obtained by differentiating the cumulative undersize curve. The peak of the frequency curve gives the modal diameter – the most commonly occurring refer the particle diameter.

The figure shows examples of the result graph types.



The result from the analysis is the relative distribution of volume of particles in the range of size classes. From this basic result the statistic of the distribution are calculated. Moreover, the span and uniformity are calculated for described the distribution of the particles. The span gives a description of the width of the distribution, which is independent of the median size. The uniformity is a measure of the absolute deviations from the median.

The interpolated results allow the cumulative undersize result to be determined for any size or the size can be determined for any percent of the total result under that

size. This latter is known as percentile. The result tables have listed the percentile size for 10%, 50%, and 90%

The 50% volume percentile, expressed as $d(v,0.5)$ is also known as the median of the volume distribution. The v in the expression shows that this refers to the volume distribution. There are the 10% and 90% cutoffs respectively for the distribution. i.e.,

$d(v,0.9)$ - 90% of the distribution is below this value

$d(v,0.1)$ - 10% of the distribution is below this value

The span of the distribution is defined as:

$$\text{Span} = \frac{d(v, 0.9) - d(v, 0.1)}{d(v, 0.5)}$$

The uniformity of the distribution is defined as:

$$\text{Uniformity} = \frac{\Sigma X_i (d(v, 0.5) - d_i)}{d(v, 0.5) \Sigma X_i}$$

where: $d(v, 0.5)$ is the median size of the distribution.

d_i and X_i are respectively the men diameter of, and result in size class I

Particle size analysis of Eudragit® E were evaluated and are presented in Table D1 and Figure D1-D6.

Table D1 Particle size of Eudragit® E

Type	D (v,0.1)	Ave.	D (v,0.5)	Ave.	D (v,0.9)	Ave.	Span	Ave.	Uniformity	Ave.
Ground	13.93		56.58		120.45		1.883		0.5914	
Eudragit®	13.74	13.76	56.43	56.54	121.42	122.5	1.908	1.92	0.5994	0.61
E 100	13.61		56.62		125.66		1.979		0.6537	
Eudragit®	1.35		10.79		19.07		1.643		0.5156	
E PO	1.37	1.363	10.70	10.75	18.47	18.72	1.599	1.61	0.4467	0.46
	1.37		10.77		18.63		1.603		0.4472	

System Details

Range Lens: 300RF mm	Beam Length: 2.40 mm	Sampler: MS17	Obscuration 4.9 %
Presentation: 3OHD	[Particle R.I. = (1.5295, 0.1000);	Dispersant R.I. = 1.3300]	
Analysis Model: Polydisperse			Residual: 0.646 %
Modifications: Active --	Killed Data Channels: Low 0; High 2		

Result Statistics

Distribution Type: Volume	Concentration = 0.0115 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 0.6000 sq. m / g
Mean Diameters:	D (v, 0.1) = 13.93 um	D (v, 0.5) = 56.58 um	D (v, 0.9) = 120.45 um
D [4, 3] = 64.02 um	D [3, 2] = 10.00 um	Span = 1.883E+00	Uniformity = 5.914E-01

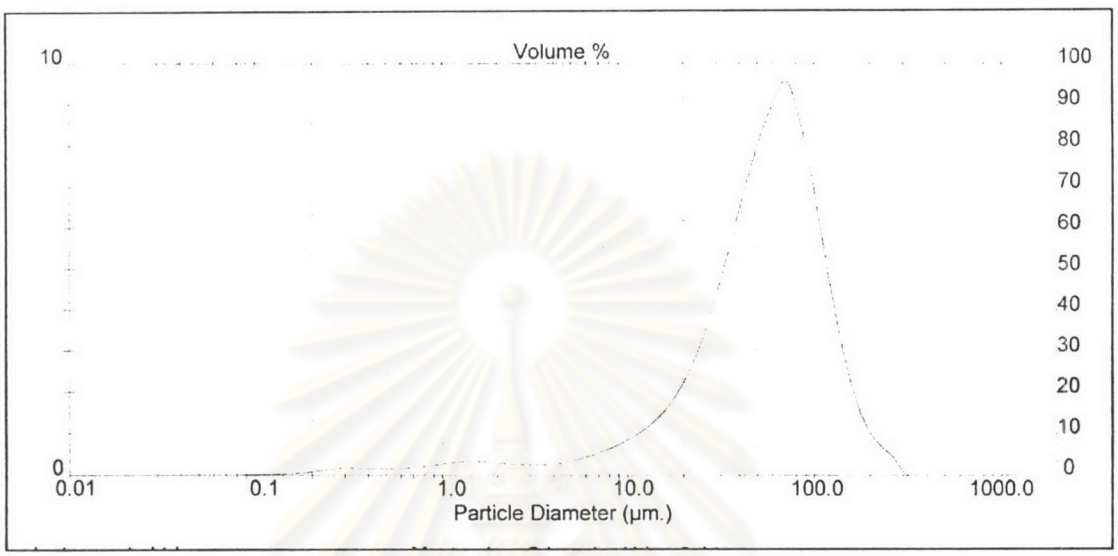


Figure D1 The size distribution curve of ground Eudragit® E 100 (n_1)

System Details

Range Lens: 300RF mm	Beam Length: 2.40 mm	Sampler: MS17	Obscuration: 4.8 %
Presentation: 3OHD	[Particle R.I. = (1.5295, 0.1000);	Dispersant R.I. = 1.3300]	
Analysis Model: Polydisperse			Residual: 0.488 %
Modifications: Active --	Killed Data Channels: Low 0; High 2		

Result Statistics

Distribution Type: Volume	Concentration = 0.0112 %Vol	Density = 1.000 g / cub. cm	Specific S.A. = 0.5993 sq. m / g
Mean Diameters:	D (v, 0.1) = 13.74 um	D (v, 0.5) = 56.43 um	D (v, 0.9) = 121.42 um
D [4, 3] = 64.14 um	D [3, 2] = 10.01 um	Span = 1.908E+00	Uniformity = 5.994E-01

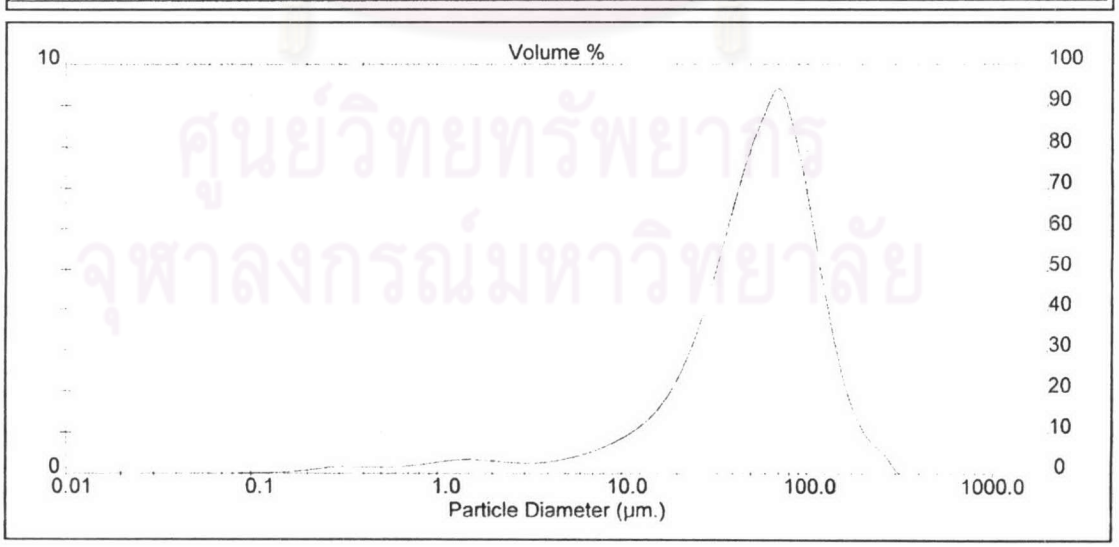


Figure D2 The size distribution curve of ground Eudragit® E 100 (n_2)

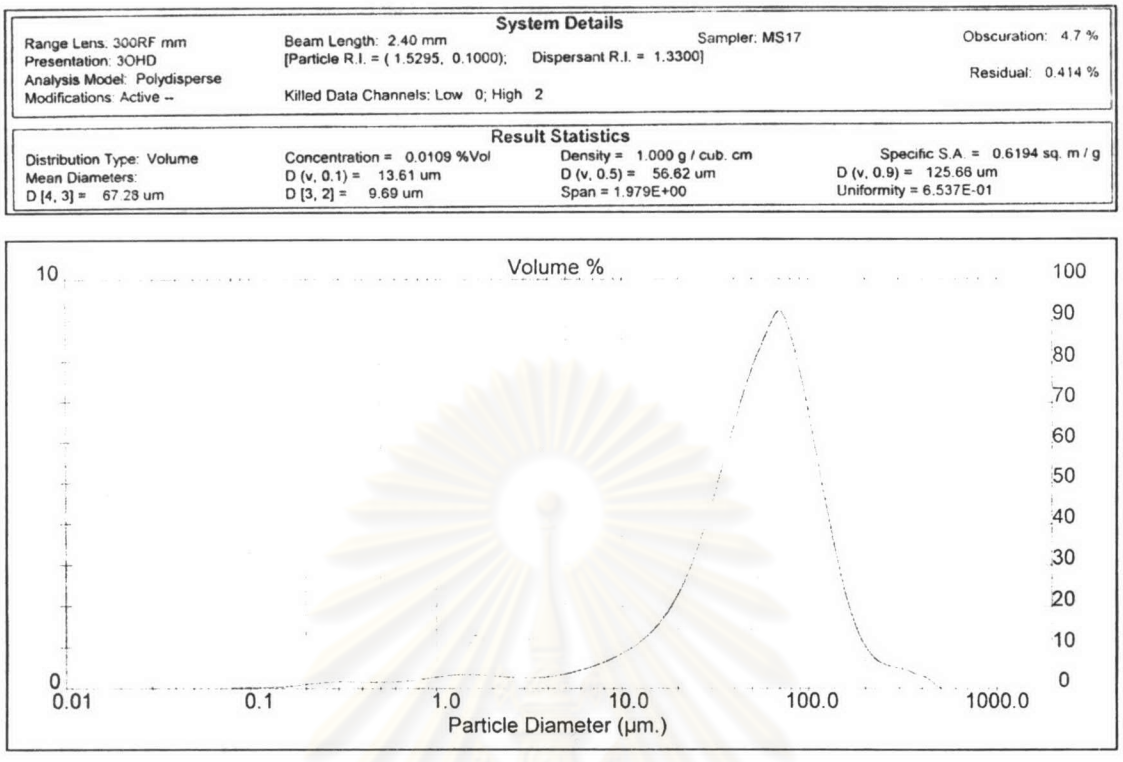


Figure D3 The size distribution curve of ground Eudragit® E 100 (n_3)

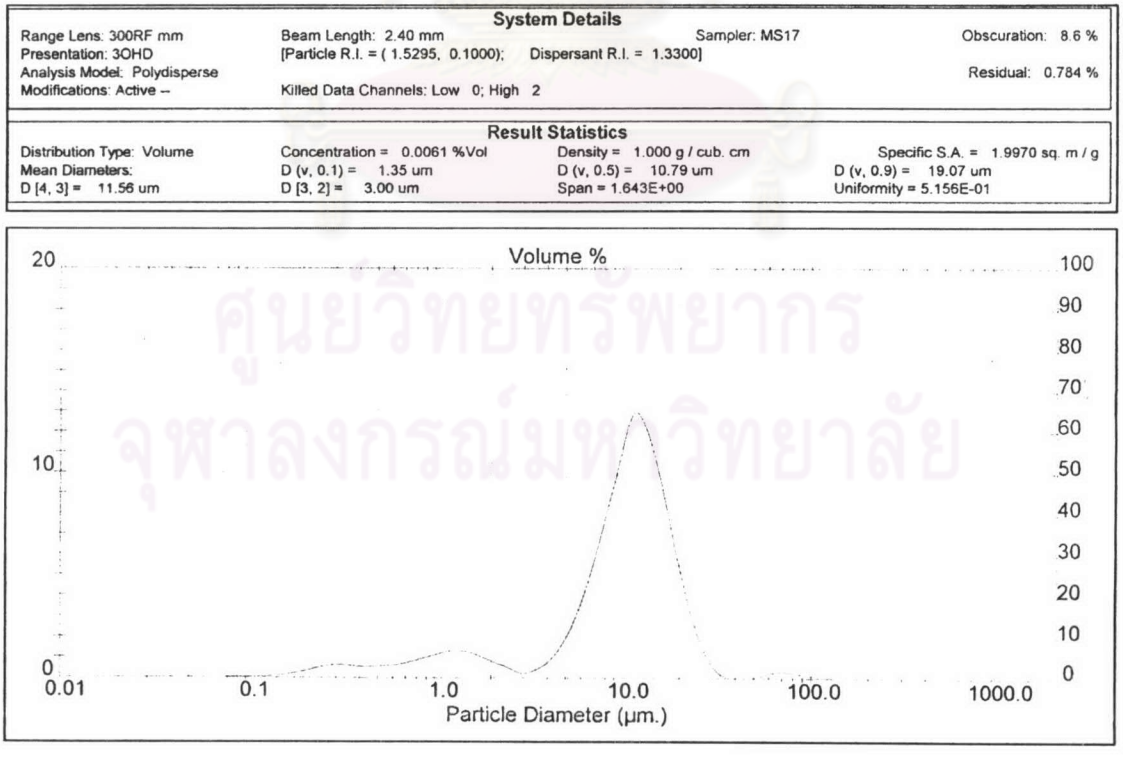


Figure D4 The size distribution curve of Eudragit® E PO (n_1)

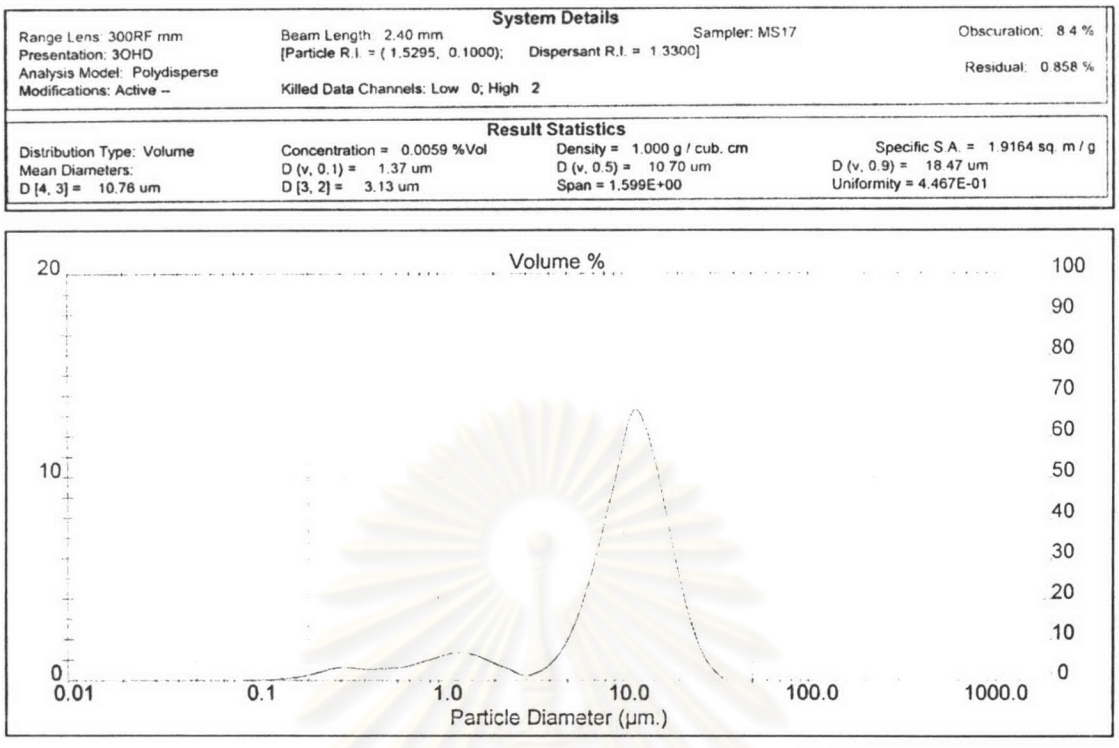


Figure D5 The size distribution curve of Eudragit® E PO (n_2)

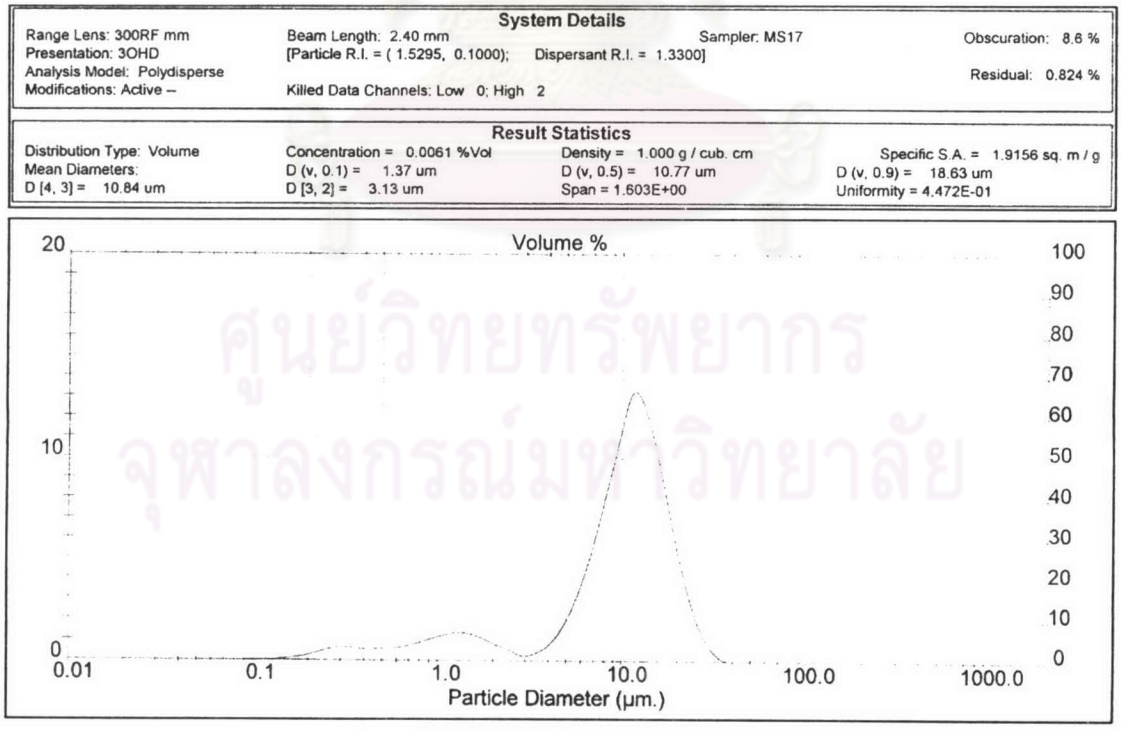


Figure D6 The size distribution curve of Eudragit® E PO (n_3)

APPENDIX E

COATING EFFICIENCY, FILM THICKNESS AND SPHERICITY, SURFACE ROUGHNESS VALUES OF PROPRANOLOL HYDROCHLORIDE COATED PELLETS

Coating efficiency

Table E1 Coating efficiency of coated propranolol hydrochloride pellets with different feed rate

Rx	Application amount (gm)	Application interval (min)	Load size of pellet (gm)	Amount of polymer (gm)	Theoretical weight (gm)	Final weight (gm)	Weight gain (gm)	Weight loss from pre-heating (gm)	Actual weight gain (gm)	Obtained coating level (%)	Coating efficiency (%)
1	2.5	15	250	25	275	256	6	2.93	8.93	3.572	35.72
2	2.5	30	250	25	275	256.5	6.5	2.93	9.43	3.772	37.72
3	2.5	60	250	25	275	255.8	5.8	2.93	8.73	3.492	34.92
4	5	15	250	25	275	259.8	9.8	2.93	11.98	4.792	47.92
5	5	30	250	25	275	259.11	9.11	2.93	12.04	4.816	48.16
6	5	60	250	25	275	258.94	8.94	2.93	11.87	4.748	47.48
7	12.5 (half)	15	250	25	275	258.2	8.2	2.93	11.13	4.452	44.52
8	12.5 (half)	30	250	25	275	259.48	9.48	2.93	12.41	4.964	49.64
9	12.5 (half)	60	250	25	275	259.66	9.66	2.93	12.59	5.036	50.36
10	25 (whole)	0	250	25	275	259.37	9.37	2.93	12.3	4.92	49.2

Table E 2 Coating efficiency of coated propranolol hydrochloride pellets with different percent coating level

Rx	Coating level (%)	Load size of pellet (gm)	Amount of polymer (gm)	Theoretical weight (gm)	Final weight (gm)	Weight gain (gm)	Weight loss from pre-heating (gm)	Actual weight gain (gm)	Obtained coating level (%)	Coating efficiency (%)
9	10	250	25	275	259.66	9.66	2.93	12.59	5.03	50.36
11	15	250	37.5	287.5	265.84	15.84	2.93	18.77	7.50	50.05
12	20	250	50	300	273.53	23.53	2.93	26.46	10.58	52.92

Table E 3 Coating efficiency of coated propranolol hydrochloride pellets (studying the effect of pellet and polymer size)

Rx	Pellet size (mesh cut)	Polymer size (micron)	Load size of pellet (gm)	Amount of polymer (gm)	Theoretical weight (gm)	Final weight (gm)	Weight gain (gm)	Weight loss from pre-heating (gm)	Actual weight gain (gm)	Obtained coating level (%)	Coating efficiency (%)
13	14/16	10	250	37.5	287.5	265.22	15.22	2.93	18.15	7.26	48.40
14	14/16	56	250	37.5	287.5	253.04	13.04	2.93	5.97	2.388	15.92
15	16/18	10	250	37.5	287.5	266.98	16.98	3.32	20.3	8.12	54.13
17	18/20	10	250	37.5	287.5	263.13	13.13	3.11	16.24	6.496	43.31

Table E 4 Coating efficiency of coated propranolol hydrochloride pellets (studying the effect of surface roughness of core pellets)

Rx	Surface appearance	Load size of pellet (gm)	Amount of polymer (gm)	Theoretical weight (gm)	Final weight (gm)	Weight gain (gm)	Weight loss from pre-heating (gm)	Actual weight gain (gm)	Obtained coating level (%)	Coating efficiency (%)
15	normal	250	37.5	287.5	266.98	16.98	3.32	20.3	8.12	54.13
19	smooth	250	37.5	287.5	262.07	12.07	3.32	15.39	6.156	41.04
20	rough	250	37.5	287.5	272.03	22.03	3.32	25.35	10.14	67.60

Table E 5 Coating efficiency of coated propranolol hydrochloride pellets (studying the effect of moisture content of core pellets)

Rx	Moisture on surface	Load size of pellet (gm)	Amount of polymer (gm)	Theoretical weight (gm)	Final weight (gm)	Weight gain (gm)	Weight loss from pre-heating (gm)	Actual weight gain (gm)	Obtained coating level (%)	Coating efficiency (%)
15	normal	250	37.5	287.5	266.98	16.98	3.32	20.3	8.12	54.13
21	Low	250	37.5	287.5	265.6	15.60	1.63	17.23	6.892	45.95
22	Lowest	250	37.5	287.5	270.01	20.01	0.97	20.98	8.392	55.95

Table E 6 Coating efficiency of coated propranolol hydrochloride pellets (studying the possibility of secondary coating layer)

Rx	Coating layer	Load size of pellet (gm)	Amount of polymer (gm)	Theoretical weight (gm)	Final weight (gm)	Weight gain (gm)	Weight loss from pre-heating (gm)	Actual weight gain (gm)	Obtained coating level (%)	Coating efficiency (%)
15	Primary coating layer	250	37.5	287.5	266.98	16.98	3.32	20.3	8.12	54.13
23	secondary coating layer	250	37.5	287.5	265.54	15.54	NA	15.54	6.216	41.44

Table E 7 Coating efficiency of coated propranolol hydrochloride pellets (studying of comparison of dry powder coating and conventional liquid-based coating for Eudragit® E PO)

Rx	Coating process	Load size of pellet (gm)	Amount of polymer (gm)	Theoretical weight (gm)	Final weight (gm)	Weight gain (gm)	Weight loss from pre-heating (gm)	Actual weight gain (gm)	Obtained coating level (%)	Coating efficiency (%)
13	15 % powder	250	37.5	287.5	265.22	15.22	2.93	18.15	7.26	48.40
24	15% fluidized	100	15	115	111.3	11.30	NA	11.3	11.3	75.33
25	5% fluidized	100	5	105	102.98	2.98	NA	2.98	2.98	59.6

Film thickness

Table E 8 Film thickness of coated propranolol hydrochloride pellets with different feed rate

Rx	Average Diameter (mm)		Film Thickness (mm)	Film Thickness (micron)	Average area (mm^2)		Area differences (mm^2)
	Core 14/16	Formulation			Core 14/16	Formulation	
Rx 1	1.2109	1.2989	0.0440	43.9906	1.19623	1.37552	0.1793
Rx 2	1.2109	1.3054	0.0472	47.2430	1.19623	1.39151	0.1953
Rx 3	1.2109	1.3133	0.0512	51.1985	1.19623	1.40672	0.2105
Rx 4	1.2109	1.3155	0.0523	52.2865	1.19623	1.41223	0.2160
Rx 5	1.2109	1.3167	0.0529	52.9060	1.19623	1.41233	0.2161
Rx 6	1.2109	1.3568	0.0729	72.9470	1.19623	1.49910	0.3029
Rx 7	1.2109	1.3400	0.0646	64.5629	1.19623	1.46051	0.2643
Rx 8	1.2109	1.3722	0.0807	80.6560	1.19623	1.53513	0.3389
Rx 9	1.2109	1.3762	0.0826	82.6176	1.19623	1.57980	0.3836
Rx 10	1.2109	1.3478	0.0684	68.4245	1.19623	1.48025	0.2840

Table E 9 Film thickness of coated propranolol hydrochloride pellets with different percent coating level

Rx	Average Diameter (mm)		Film Thickness (mm)	Film Thickness (micron)	Average area (mm^2)		Area differences (mm^2)
	Core 14/16	Formulation			Core 14/16	Formulation	
10 % coating	1.2109	1.3762	0.0826	82.6176	1.19623	1.57980	0.3836
15 % coating	1.2109	1.3771	0.0831	83.1010	1.19623	1.47772	0.2815
20 % coating	1.2109	1.3772	0.0831	83.1311	1.19623	1.49223	0.2960

Table E 10 Film thickness of coated propranolol hydrochloride pellets (studying the effect of pellet and polymer size)

Rx	Average Diameter (mm)		Film Thickness (mm)	Film Thickness (micron)	Average area (mm^2)		Area differences (mm^2)
	Core 14/16	Formulation			Core 14/16	Formulation	
13	1.21092	1.36836	0.0787	78.7195	1.19623	1.49190	0.2957
14	1.21092	1.32766	0.0584	58.3685	1.19623	1.45567	0.2594
15	**Core 16/18**	**Formulation**			**Core 16/18**	**Formulation**	
	1.04310	1.15132	0.0541	54.1100	0.89235	1.08451	0.1922
17	**Core 18/20**	**Formulation**			**Core 18/20**	**Formulation**	
	0.87122	0.97362	0.0512	51.2005	0.62563	0.80878	0.1831

Table E 11 Film thickness of coated propranolol hydrochloride pellets (studying the effect of surface roughness of core pellets)

Rx	Average Diameter (mm)		Film Thickness (mm)	Film Thickness (micron)	Average area (mm^2)		Area differences (mm^2)
	Normal core	Formulation			Normal core	Formulation	
15	1.04310	1.15132	0.0541	54.1100	0.89235	1.08451	0.1922
19	**Smooth core**	**Formulation**			**Smooth core**	**Formulation**	
	1.03356	1.14393	0.0552	55.1839	0.87550	1.07118	0.1957
20	**Rough core**	**Formulation**			**Rough core**	**Formulation**	
	1.08333	1.12566	0.0212	21.1660	0.96013	1.04031	0.0802

Table E 12 Film thickness of coated propranolol hydrochloride pellets (studying the effect of moisture content of core pellets)

Rx	Average Diameter (mm)		Film Thickness (mm)	Film Thickness (micron)	Average area (mm^2)		Area differences (mm^2)
	Core 16/18	Formulation			Core 16/18	Formulation	
15	1.04310	1.15132	0.0541	54.1100	0.89235	1.08451	0.1922
21	**Low moist**	**Formulation**			**Low moist**	**Formulation**	
	1.04977	1.15039	0.05031	50.3100	0.89713	1.08095	0.1837
22	**Lowest moist**	**Formulation**			**Lowest moist**	**Formulation**	
	1.04258	1.1597	0.05856	58.56	0.89194	1.10021	0.2083

Table E 13 Film thickness of coated propranolol hydrochloride pellets (studying the possibility of secondary coating layer)

Rx	Average Diameter (mm)		Film Thickness (mm)	Film Thickness (micron)	Average area (mm^2)		Area differences (mm^2)
	Core 16/18	Formulation			Core 16/18	Formulation	
15	1.04310	1.15132	0.0541	54.1100	0.89235	1.08451	0.1922
23	**Coated rx 15**	**Formulation**			**Coated rx 15**	**Formulation**	
	1.1513	1.2618	0.0552	55.2410	1.08451	1.28560	0.2011

Table E 14 Film thickness of coated propranolol hydrochloride pellets (studying of comparison of dry powder coating and conventional liquid-based coating for Eudragit® E PO)

Rx	Average Diameter (mm)		Film Thickness (mm)	Film Thickness (micron)	Average area (mm^2)		Area differences (mm^2)
	Core 14/16	Formulation			Core 14/16	Formulation	
15 % powder	1.2109	1.3762	0.0826	82.6176	1.19623	1.57980	0.3836
15 % Fluidized	1.2109	1.4135	0.1013	101.2965	1.19623	1.62861	0.4324
5 % Fluidized	1.2109	1.3284	0.0587	58.7460	1.19623	1.43802	0.2418

Sphericity and surface roughness values

Table E 15 Sphericity of coated propranolol hydrochloride pellets with different feed rate (n = 100).

Rx	Mean values (SD)			
	Roundness	**Aspect ratio**	**Elongation**	**Fractal Dimension**
core 14/16	0.92512 (0.04307)	1.07794 (0.05494)	1.10241 (0.05174)	1.05726 (0.00318)
Rx 1	0.90485 (0.04307)	1.09773 (0.05134)	1.12108 (0.04846)	1.05539 (0.00344)
Rx 2	0.90035 (0.04466)	1.10340 (0.06568)	1.12669 (0.05797)	1.05560 (0.00401)
Rx 3	0.90017 (0.05390)	1.10839 (0.08030)	1.13111 (0.07533)	1.05470 (0.00298)
Rx 4	0.90741 (0.05051)	1.09408 (0.06900)	1.11698 (0.06094)	1.05554 (0.00490)
Rx 5	0.90584 (0.04590)	1.09757 (0.06014)	1.12071 (0.05740)	1.05671 (0.00423)
Rx 6	0.90128 (0.04745)	1.09834 (0.05923)	1.12252 (0.05239)	1.05537 (0.00467)
Rx 7	0.90110 (0.04142)	1.09989 (0.04859)	1.12165 (0.04551)	1.05633 (0.00321)
Rx 8	0.90975 (0.03148)	1.09408 (0.03366)	1.11187 (0.03488)	1.05528 (0.00575)
Rx 9	0.90077 (0.03695)	1.09903 (0.04712)	1.12398 (0.04408)	1.05401 (0.00344)
Rx 10	0.90176 (0.04232)	1.09287 (0.05640)	1.12050 (0.05301)	1.05470 (0.00327)

Table E 16 Sphericity of coated propranolol hydrochloride pellets with different percent coating level(n = 100).

Rx	Mean values (SD)			
	Roundness	**Aspect ratio**	**Elongation**	**Fractal Dimension**
core 14/16	0.92512 (0.04307)	1.07794 (0.05494)	1.10241 (0.05174)	1.05726 (0.00318)
10 % coating	0.90077 (0.03695)	1.09903 (0.04712)	1.12398 (0.04408)	1.05401 (0.00344)
15 % coating	0.90942 (0.03508)	1.08413 (0.04304)	1.11070 (0.04025)	1.05445 (0.00321)
20 % coating	0.91493 (0.04457)	1.08337 (0.05177)	1.10703 (0.04751)	1.05416 (0.00352)

Table E 17 Sphericity of coated propranolol hydrochloride pellets (the effect of pellet and polymer size) (n = 100).

Rx	Mean values (SD)			
	Roundness	**Aspect ratio**	**Elongation**	**Fractal Dimension**
core 14/16	0.92512 (0.04307)	1.07794 (0.05494)	1.10241 (0.05174)	1.05726 (0.00318)
Rx 13	0.90514 (0.04656)	1.09729 (0.06147)	1.11955 (0.05896)	1.05437 (0.00345)
Rx 14	0.87761 (0.04768)	1.08698 (0.05186)	1.12200 (0.04904)	1.07041 (0.00918)
Core 16/18	0.92312 (0.04525)	1.08474 (0.06247)	1.10921 (0.05868)	1.05904 (0.00355)
Rx 15	0.90046 (0.04707)	1.09883 (0.05651)	1.12459 (0.05322)	1.05452 (0.00404)
Core 18/20	0.92261 (0.05199)	1.09490 (0.06774)	1.12103 (0.06707)	1.05882 (0.00465)
Rx 17	0.91389 (0.04683)	1.09405 (0.06216)	1.11868 (0.05682)	1.05760 (0.00368)

Table E 18 Sphericity of coated propranolol hydrochloride pellets (the effect of surface roughness of core pellets) (n = 100).

Rx	Mean values (SD)			
	Roundness	**Aspect ratio**	**Elongation**	**Fractal Dimension**
core 16/18	0.92312 (0.04525)	1.08474 (0.06247)	1.10921 (0.05868)	1.05904 (0.00355)
Rx 15	0.90046 (0.04707)	1.09883 (0.05651)	1.12459 (0.05322)	1.05452 (0.00404)
Smooth core	0.95290 (0.02465)	1.05413 (0.03149)	1.07828 (0.03066)	**1.05801 (0.00304)**
Rx 19	0.93054 (0.03488)	1.06183 (0.03752)	1.09149 (0.03471)	1.05621 (0.00330)
Rough core	0.89354 (0.05498)	1.10936 (0.07178)	1.13521 (0.06950)	1.06205 (0.00665)
Rx 20	0.88974 (0.04780)	1.11883 (0.07667)	1.13895 (0.06301)	1.06247 (0.00975)

Table E 19 Sphericity of coated propranolol hydrochloride pellets (the effect of moisture content of core pellets) (n = 100).

Rx	Mean values (SD)			
	Roundness	**Aspect ratio**	**Elongation**	**Fractal Dimension**
core 16/18	0.92312 (0.04525)	1.08474 (0.06247)	1.10921 (0.05868)	1.05904 (0.00355)
Rx 15	0.90046 (0.04707)	1.09883 (0.05651)	1.12459 (0.05322)	1.05452 (0.00404)
Core low moist	0.93035 (0.07826)	1.07951 (0.09541)	1.10216 (0.08751)	1.05817 (0.00572)
Rx 21	0.91002 (0.04391)	1.09210 (0.05887)	1.11788 (0.05494)	1.05758 (0.00409)
Core lowest moist	0.92112 (0.09424)	1.08164 (0.07845)	1.10745 (0.11035)	1.06078 (0.00612)
Rx 22	0.90695 (0.04592)	1.10116 (0.05990)	1.12404 (0.05613)	1.05740 (0.00343)

Table E 20 Sphericity of coated propranolol hydrochloride pellets (the possibility of secondary coating layer(n = 100).

Rx	Mean values (SD)			
	Roundness	**Aspect ratio**	**Elongation**	**Fractal Dimension**
core 16/18	0.92312 (0.04525)	1.08474 (0.06247)	1.10921 (0.05868)	1.05904 (0.00355)
Rx 15	0.90046 (0.04707)	1.09883 (0.05651)	1.12459 (0.05322)	1.05452 (0.00404)
Rx 23	0.83533 (0.14364)	1.28329 (0.37071)	1.27513 (0.30857)	1.05746 (0.00637)

Table E 21 Sphericity of coated propranolol hydrochloride pellets (study on the comparison of dry powder coating and conventional liquid-based coating for Eudragit® E PO) (n = 100).

Rx	Mean values (SD)			
	Roundness	**Aspect ratio**	**Elongation**	**Fractal Dimension**
core 14/16	0.92512 (0.04307)	1.07794 (0.05494)	1.10241 (0.05174)	1.05726 (0.00318)
15 % powder	0.90514 (0.04656)	1.09729 (0.06147)	1.11955 (0.05896)	1.05437 (0.00345)
15 % Fluidized	0.91017 (0.04320)	1.08728 (0.05507)	1.11391 (0.05092)	1.05497 (0.00336)
5 % Fluidized	0.90317 (0.04732)	1.09477 (0.06277)	1.12117 (0.06114)	1.05540 (0.00326)

APPENDIX F

DRUG RELEASE DATA

Table F1 Percent amounts of propranolol hydrochloride release from core pellets (14/16 mesh cut)

Time (min)	Amount Release (mg)					% Drug release				
	1	2	3	Ave	SD	1	2	3	Ave	SD
0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
1	5.81	7.13	6.61	6.51	0.67	14.50	17.77	16.52	16.26	1.65
4	15.85	16.20	16.04	16.03	0.18	39.59	40.38	40.10	40.02	0.40
7	22.51	23.13	22.62	22.75	0.33	56.24	57.65	56.56	56.81	0.74
10	27.99	28.61	28.35	28.32	0.31	69.92	71.31	70.88	70.70	0.71
13	31.78	32.34	31.83	31.98	0.31	79.37	80.60	79.60	79.86	0.65
16	34.41	35.08	34.69	34.73	0.34	85.94	87.44	86.74	86.71	0.75
20	37.10	37.66	37.29	37.35	0.28	92.67	93.86	93.24	93.26	0.59
25	39.23	39.56	39.25	39.35	0.19	97.99	98.61	98.15	98.25	0.32
30	40.16	40.50	40.14	40.27	0.20	100.32	100.94	100.36	100.54	0.35
45	40.75	40.90	40.66	40.77	0.12	101.78	101.95	101.66	101.80	0.14
60	40.74	40.84	40.59	40.72	0.12	101.76	101.79	101.49	101.68	0.16

Table F2 Percent amounts of propranolol hydrochloride coated pellets release from series of different % coating levels

Formulations	Time (min)	Amount Release (mg)					% Drug release				
		1	2	3	Ave	SD	1	2	3	Ave	SD
Propranolol hydrochloride coated pellets with 10 % coating level (Rx 9)	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	5.61	6.34	6.02	5.99	0.37	13.97	15.83	15.02	14.94	0.93
	4	15.55	15.66	15.20	15.47	0.24	38.73	39.12	37.89	38.58	0.63
	7	22.30	22.30	21.78	22.13	0.30	55.56	55.73	54.31	55.20	0.78
	10	27.84	27.61	26.96	27.47	0.46	69.35	68.98	67.23	68.52	1.13
	13	31.36	31.30	30.82	31.16	0.29	78.11	78.21	76.86	77.73	0.75
	16	34.07	34.05	33.69	33.94	0.21	84.86	85.09	84.01	84.65	0.57
	20	36.63	36.66	36.32	36.54	0.19	91.25	91.61	90.57	91.14	0.53
	25	38.37	38.49	37.63	38.16	0.47	95.59	96.18	93.83	95.20	1.23
	30	39.26	39.39	38.60	39.08	0.42	97.80	98.42	96.26	97.49	1.11
	45	39.77	39.93	39.09	39.60	0.45	99.08	99.79	97.47	98.78	1.19
	60	39.76	40.10	39.14	39.67	0.48	99.05	100.19	97.61	98.95	1.29
Propranolol hydrochloride coated pellets with 15 % coating level (Rx 13)	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	4.38	4.58	7.14	5.37	1.54	10.87	11.38	17.77	13.34	3.84
	4	14.53	14.84	16.04	15.14	0.80	36.06	36.89	39.92	37.63	2.03
	7	22.00	21.90	22.70	22.20	0.44	54.62	54.42	56.48	55.18	1.14
	10	27.72	27.71	28.52	27.99	0.47	68.82	68.88	70.97	69.56	1.22
	13	31.30	31.44	31.83	31.52	0.28	77.70	78.15	79.19	78.35	0.76
	16	33.95	34.26	34.65	34.28	0.35	84.28	85.14	86.20	85.21	0.96
	20	36.73	36.71	36.88	36.77	0.09	91.20	91.24	91.75	91.40	0.31
	25	38.07	38.25	38.21	38.17	0.09	94.52	95.06	95.06	94.88	0.31
	30	38.73	38.71	38.57	38.67	0.09	96.17	96.22	95.97	96.12	0.13
	45	38.93	38.95	38.89	38.92	0.03	96.67	96.80	96.75	96.74	0.06
	60	39.15	39.22	39.22	39.20	0.04	97.21	97.47	97.58	97.42	0.19
Propranolol hydrochloride coated pellets with 20 % coating level (Rx12)	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	3.60	4.44	6.33	4.79	1.40	8.99	11.06	15.75	11.93	3.46
	4	13.11	13.12	14.33	13.52	0.70	32.80	32.66	35.63	33.70	1.68
	7	19.70	20.56	20.92	20.39	0.63	49.26	51.19	52.03	50.83	1.42
	10	25.29	26.37	26.38	26.01	0.63	63.24	65.66	65.61	64.84	1.38
	13	28.85	29.69	30.12	29.55	0.64	72.14	73.91	74.90	73.65	1.40
	16	31.59	32.34	32.53	32.15	0.50	79.00	80.51	80.91	80.14	1.01
	20	34.02	34.74	35.03	34.60	0.52	85.06	86.50	87.13	86.23	1.06
	25	35.81	36.32	36.44	36.19	0.33	89.54	90.42	90.63	90.20	0.57
	30	36.58	36.99	36.82	36.80	0.21	91.46	92.09	91.58	91.71	0.33
	45	36.84	36.95	37.09	36.96	0.12	92.12	91.99	92.24	92.11	0.13
	60	36.86	37.14	37.26	37.08	0.20	92.17	92.45	92.66	92.43	0.25

Table F3 Percent amounts of propranolol hydrochloride coated pellets release from series of different curing condition

Formulations	Time (min)	Amount Release (mg)					% Drug release				
		1	2	3	Ave	SD	1	2	3	Ave	SD
Propranolol hydrochloride coated pellets before curing	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	6.16	4.40	5.56	5.37	0.90	15.42	10.97	13.85	13.42	2.26
	4	15.34	14.37	15.47	15.06	0.60	38.40	35.87	38.52	37.59	1.50
	7	21.54	21.00	21.96	21.50	0.48	53.91	52.41	54.68	53.67	1.16
	10	26.92	26.59	27.41	26.97	0.41	67.39	66.37	68.27	67.34	0.95
	13	30.51	30.41	30.91	30.61	0.27	76.38	75.90	76.99	76.42	0.55
	16	33.27	33.07	33.48	33.27	0.21	83.30	82.52	83.38	83.07	0.47
	20	35.63	35.57	35.92	35.71	0.18	89.21	88.79	89.45	89.15	0.34
	25	37.42	37.37	37.59	37.46	0.12	93.70	93.27	93.63	93.53	0.23
	30	38.19	38.25	38.45	38.30	0.14	95.60	95.47	95.76	95.61	0.14
	45	38.62	38.62	38.87	38.71	0.14	96.69	96.39	96.81	96.63	0.22
	60	38.59	38.74	38.88	38.74	0.14	96.62	96.69	96.82	96.71	0.10
Propranolol hydrochloride coated pellets curing at 90 ° C, 2hr.	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	4.30	3.36	4.19	3.95	0.52	10.73	8.36	10.47	9.86	1.30
	4	14.68	14.41	13.32	14.13	0.72	36.63	35.89	33.30	35.28	1.75
	7	21.75	21.17	20.91	21.28	0.43	54.28	52.72	52.30	53.10	1.04
	10	27.02	26.79	26.22	26.67	0.41	67.44	66.72	65.57	66.57	0.94
	13	30.73	30.65	29.97	30.45	0.42	76.69	76.33	74.96	76.00	0.92
	16	33.43	33.42	32.68	33.18	0.43	83.44	83.23	81.73	82.80	0.93
	20	35.95	35.83	35.33	35.70	0.33	89.72	89.24	88.35	89.10	0.70
	25	37.91	37.89	37.13	37.65	0.44	94.62	94.37	92.86	93.95	0.95
	30	38.37	38.50	37.79	38.22	0.38	95.77	95.89	94.50	95.39	0.77
	45	38.99	39.09	38.39	38.82	0.38	97.30	97.35	96.01	96.89	0.76
	60	38.94	39.08	38.30	38.77	0.41	97.18	97.32	95.79	96.76	0.85
Propranolol hydrochloride coated pellets curing at 90 ° C, 8 hr.	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	4.38	4.58	7.14	5.37	1.54	10.87	11.38	17.77	13.34	3.84
	4	14.53	14.84	16.04	15.14	0.80	36.06	36.89	39.92	37.63	2.03
	7	22.00	21.90	22.70	22.20	0.44	54.62	54.42	56.48	55.18	1.14
	10	27.72	27.71	28.52	27.99	0.47	68.82	68.88	70.97	69.56	1.22
	13	31.30	31.44	31.83	31.52	0.28	77.70	78.15	79.19	78.35	0.76
	16	33.95	34.26	34.65	34.28	0.35	84.28	85.14	86.20	85.21	0.96
	20	36.73	36.71	36.88	36.77	0.09	91.20	91.24	91.75	91.40	0.31
	25	38.07	38.25	38.21	38.17	0.09	94.52	95.06	95.06	94.88	0.31
	30	38.73	38.71	38.57	38.67	0.09	96.17	96.22	95.97	96.12	0.13
	45	38.93	38.95	38.89	38.92	0.03	96.67	96.80	96.75	96.74	0.06
	60	39.15	39.22	39.22	39.20	0.04	97.21	97.47	97.58	97.42	0.19

Table F3 (continued) Percent amounts of propranolol hydrochloride coated pellets release from series of different curing condition.

Formulations	Time (min)	Amount Release (mg)					% Drug release				
		1	2	3	Ave	SD	1	2	3	Ave	SD
Propranolol hydrochloride coated pellets curing at 90 ° C, 24 hr.	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	4.28	4.21	5.52	4.67	0.74	10.64	10.52	13.74	11.63	1.82
	4	13.36	14.92	15.30	14.53	1.03	33.23	37.28	38.06	36.19	2.59
	7	20.51	22.16	22.30	21.65	1.00	51.02	55.36	55.47	53.95	2.54
	10	26.41	27.44	27.43	27.09	0.59	65.70	68.56	68.25	67.50	1.57
	13	30.60	31.08	31.24	30.97	0.33	76.14	77.64	77.74	77.17	0.89
	16	33.67	33.74	33.96	33.79	0.15	83.77	84.30	84.49	84.18	0.37
	20	36.26	36.30	36.32	36.29	0.03	90.23	90.70	90.36	90.43	0.24
	25	37.86	37.73	38.06	37.88	0.17	94.20	94.26	94.69	94.38	0.27
	30	38.73	38.43	38.90	38.68	0.24	96.36	96.00	96.78	96.38	0.39
	45	39.23	38.84	39.42	39.16	0.30	97.60	97.03	98.07	97.57	0.52
	60	39.24	38.80	39.30	39.11	0.28	97.62	96.93	97.79	97.45	0.46

Table F4 Percent amounts of propranolol hydrochloride coated pellets release from primary and secondary coating layer

Formulations	Time (min)	Amount Release (mg)					% Drug release				
		1	2	3	Ave	SD	1	2	3	Ave	SD
Core 16/18	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	6.10	6.75	6.64	6.50	0.35	15.75	16.74	16.29	16.26	0.50
	4	18.57	18.77	19.74	19.03	0.63	46.94	47.79	47.98	47.57	0.55
	7	26.27	25.95	26.98	26.40	0.53	65.89	65.13	66.95	65.99	0.91
	10	31.38	31.86	31.23	31.49	0.33	78.76	79.61	77.79	78.72	0.91
	13	35.13	34.70	34.70	34.84	0.25	87.86	86.74	86.74	87.11	0.65
	16	37.18	37.64	36.38	37.07	0.64	92.63	93.45	91.94	92.67	0.76
	20	38.29	38.34	38.89	38.51	0.33	95.59	96.48	96.73	96.27	0.60
	25	39.74	40.47	39.33	39.85	0.58	99.66	100.24	99.01	99.64	0.62
	30	40.45	40.24	40.85	40.51	0.31	101.27	100.85	101.68	101.27	0.42
	45	39.80	41.84	40.66	40.77	1.02	101.76	102.18	101.82	101.92	0.23
	60	40.95	39.87	40.83	40.55	0.59	101.83	100.61	101.69	101.38	0.67
Propranolol hydrochloride primary coating layer coated pellets (Rx15)	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	4.75	5.10	6.14	5.33	0.72	11.86	12.74	15.39	13.33	1.84
	4	18.17	17.74	18.30	18.07	0.30	45.35	44.31	45.86	45.17	0.79
	7	25.61	25.65	25.98	25.75	0.20	63.90	64.07	65.08	64.35	0.64
	10	31.09	31.01	31.01	31.04	0.04	77.56	77.46	77.69	77.57	0.12
	13	34.01	34.33	34.40	34.25	0.21	84.86	85.74	86.19	85.60	0.67
	16	36.48	36.38	36.58	36.48	0.10	91.03	90.85	91.64	91.17	0.41
	20	37.69	37.74	37.89	37.78	0.10	94.05	94.27	94.93	94.41	0.46
	25	38.34	38.53	38.68	38.52	0.17	95.66	96.24	96.90	96.27	0.62
	30	38.56	38.74	38.96	38.75	0.20	96.21	96.75	97.60	96.85	0.70
	45	38.66	38.84	38.77	38.76	0.09	96.46	97.01	97.12	96.86	0.36
	60	38.80	38.83	38.95	38.86	0.08	96.79	96.97	97.59	97.12	0.42
Propranolol hydrochloride secondary coating layer coated pellets (Rx 23)	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	4.87	4.47	5.75	5.03	0.65	12.18	11.21	14.34	12.58	1.60
	4	17.05	16.34	17.22	16.87	0.47	42.68	40.95	42.95	42.19	1.08
	7	24.93	24.38	25.83	25.05	0.73	62.41	61.10	64.42	62.64	1.67
	10	29.74	29.94	30.88	30.19	0.61	74.46	75.02	77.01	75.50	1.34
	13	33.05	33.40	33.99	33.48	0.47	82.74	83.70	84.76	83.73	1.01
	16	35.31	35.45	36.36	35.71	0.57	88.41	88.84	90.68	89.31	1.20
	20	36.89	37.19	38.01	37.36	0.58	92.35	93.20	94.79	93.45	1.24
	25	37.76	38.10	38.93	38.26	0.60	94.54	95.47	97.09	95.70	1.29
	30	37.74	38.25	39.05	38.34	0.66	94.48	95.86	97.37	95.90	1.45
	45	37.87	38.40	39.34	38.54	0.74	94.81	96.23	98.10	96.38	1.65
	60	38.16	38.33	39.16	38.55	0.54	95.54	96.05	97.66	96.42	1.11

Table F5 Percent amounts of propranolol hydrochloride coated pellets release from different process of coating.

Formulations	Time (min)	Amount Release (mg)					% Drug release				
		1	2	3	Ave	SD	1	2	3	Ave	SD
Propranolol hydrochloride coated pellets by liquid – based coating (Rx 24)	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	4.14	3.67	3.48	3.76	0.34	10.34	9.12	8.72	9.39	0.84
	4	13.98	13.18	13.18	13.45	0.46	34.88	32.79	32.98	33.55	1.16
	7	20.65	20.05	20.02	20.24	0.36	51.51	49.87	50.09	50.49	0.89
	10	26.29	25.85	25.91	26.02	0.24	65.60	64.30	64.84	64.91	0.65
	13	29.63	29.60	29.26	29.50	0.20	73.92	73.63	73.23	73.59	0.34
	16	32.25	32.25	31.65	32.05	0.35	80.46	80.22	79.20	79.96	0.67
	20	34.54	34.42	34.17	34.37	0.19	86.17	85.60	85.51	85.76	0.36
	25	36.02	36.17	35.66	35.95	0.26	89.86	89.95	89.24	89.68	0.39
	30	37.11	36.88	37.05	37.01	0.12	92.58	91.72	92.73	92.34	0.54
	45	37.58	37.35	37.07	37.33	0.26	93.76	92.89	92.77	93.14	0.54
	60	37.54	37.43	37.17	37.38	0.19	93.66	93.11	93.01	93.26	0.35
Propranolol hydrochloride coated pellets by dry powder coating (Rx 13)	0	0.02	0.02	0.02	0.02	0.00	0.06	0.06	0.06	0.06	0.00
	1	4.38	4.58	7.14	5.37	1.54	10.87	11.38	17.77	13.34	3.84
	4	14.53	14.84	16.04	15.14	0.80	36.06	36.89	39.92	37.63	2.03
	7	22.00	21.90	22.70	22.20	0.44	54.62	54.42	56.48	55.18	1.14
	10	27.72	27.71	28.52	27.99	0.47	68.82	68.88	70.97	69.56	1.22
	13	31.30	31.44	31.83	31.52	0.28	77.70	78.15	79.19	78.35	0.76
	16	33.95	34.26	34.65	34.28	0.35	84.28	85.14	86.20	85.21	0.96
	20	36.73	36.71	36.88	36.77	0.09	91.20	91.24	91.75	91.40	0.31
	25	38.07	38.25	38.21	38.17	0.09	94.52	95.06	95.06	94.88	0.31
	30	38.73	38.71	38.57	38.67	0.09	96.17	96.22	95.97	96.12	0.13
	45	38.93	38.95	38.89	38.92	0.03	96.67	96.80	96.75	96.74	0.06
	60	39.15	39.22	39.22	39.20	0.04	97.21	97.47	97.58	97.42	0.19

APPENDIX G

SIMILARY FACTOR DATA

The indication of different dissolution profiles was tough to justify by using only visual observation from dissolution pattern comparison. In this experiment, we chose similarity factor (f_2) for assessing the similarity of two dissolution profiles.

Conceptually, f_2 is a function of the reciprocal of men square transform of the sum square distances at all point and could be implied as similarity factor. If the two dissolution profile re identical then f_2 is close to 100. By the way, inequality between dissolution profile was determined as values for displaying the magnitude of the difference. Average percentage of difference, which calculated form this equation, was very useful parameter to indicate the different dissolution profiles.

$$f_2 = 50\log\{[1+(\text{percent average difference})^2]^{-1/2} * 100\}$$

Empirically from the experience in dissolution data analysis, many researchers agree that an average difference of not more than 10 % at any sample time point, of the batches of the same formulation may be acceptable that mean f_2 become approach to 50 for simplicity. So, we considered that the test batch dissolution similar to the reference batch, if the f_2 value of the two true profiles is not less than 50. We use this criteria for studied and determined about dissolution profile in this experiment.

The example of various average percentages difference and limit of similarity factor are given in Table . If the data of similarity factor could be obtained then the average percentage difference was calculated from the equation. The higher percentage difference indicate the numerous unlikable.

Table G1 Relationship between average percentage difference and similarity factor "f_2" of two dissolution profiles.

Average percentage difference	Limit of similarity factor*
1	92.47
2	82.53
3	75.00
4	69.24
5	64.63
6	60.80
7	57.53
8	54.68
9	52.15
10	50.00

* Limit of similarity factor is computed according to the equation.

Table G2 Similarity factor between dissolution profiles of propranolol hydrochloride coated pellet from series of different % coating levels

Formulation	Similarity factor "f2"
Core 14/16: coated 10 % coating level	84.10
Core 14/16: coated15 % coating level	83.00
Core 14/16: coated 20 % coating level	61.07
Coated 10 % : 15% coating level	93.18
Coated 10 % : 20% coating level	68.57
Coated 15 % : 20% coating level	68.18

* Using dissolution curve of propranolol hydrochloride core pellets (14/16 mesh cut) as reference

Table G3 Similarity factor between dissolution profiles of propranolol hydrochloride coated pellet from series of different curing condition

Formulation	Similarity factor "f2"
Core 14/16: before curing	73.93
Core 14/16: cured 2hr	66.57
Core 14/16: cured 8hr	83.00
Core 14/16: cured 24hr	72.70
Before curing: cured 2 hr	84.43
Before curing: curing 8 hr	86.13
Before curing: curing 24 hr	91.55
Cured 2 hr: cured 8 hr	77.37
Cured 2 hr: cured 24 hr	90.18
Cured 8 hr: cured 24 hr	87.37

* Using dissolution curve of propranolol hydrochloride core pellets (14/16 mesh cut) as reference

Table G4 Similarity factor between dissolution profiles of propranolol hydrochloride coated pellet from primary and secondary coating layer

Formulation	Similarity factor "f2"
Core 16/18: primary layer coating	82.27
Core 16/18: secondary layer coating	69.84
Primary: secondary layer coating	82.46

* Using dissolution curve of propranolol hydrochloride coated pellets (16/18 mesh cut) as reference.

Table G5 Similarity factor between dissolution profiles of propranolol hydrochloride coated pellet from different process of coating.

Formulation	Similarity factor "f2"
Core 14/16: 15 % coating level of dry powder coating	66.45
Core 14/16: 15 % coating level of liquid-based coating	59.36
15 % coating level of dry powder: 15 % coating level of liquid-based coating	82.95

* Using dissolution curve of propranolol hydrochloride core pellets (14/16 mesh cut) as reference

APPENDIX H

PHYSICOCHEMICAL DATA

Table H1 Characteristic peaks of the X-ray diffraction patterns of coated pellets

Formulations	Characteristic Peaks (2θ)
Propranolol hydrochloride	9.700, 12.400, 12.740, 16.620, 17.080, 19.460, 21.140, 21.960, 23.580, 24.980, 27.020, 29.440
Avicel® PH 101	14.94, 22.54, 34.62
Corn starch	15.12, 17.04, 18.12, 22.96
Eudagit® E PO	7.76, 17.22
Eudagit® E PO thermal treated at 90 °C, 8hr	7.68, 17.46
Eudagit® E PO thermal treated at 90 °C, 8hr	7.54, 17.52
Ground Eudagit® E 100	7.44, 17.44
Physical mix (core pellets)	9.640, 12.400, 12.720, 16.620, 17.100, 19.440, 21.140, 21.960, 23.560, 24.980, 26.980, 29.380
Coated pellets	9.720, 12.440, 12.800, 16.680, 17.410, 19.840, 21.200, 22.060, 23.600, 25.040, 27.040, 29.520

Table H2 Characteristic peaks of the IR spectra of coated pellets

Formulations	Characteristic Peaks (cm^{-1})
Propranolol hydrochloride	770, 797, 1105, 1240, 1267, 1398, 1453, 1579
Avicel® PH 101	3300-3400
Corn starch	3300-3400
Lactose	3300-3400
Eudagit® E PO	1143-1176, 1241, 1269, 1384, 1460-1482, 1728, 2363, 2768, 2823, 2949, 3437
Eudagit® E PO thermal treated at 90 °C, 8hr	1149-1184, 1238, 1268, 1385, 1453-1478, 1726, 2355, 2768, 2819, 2954, 3451
Eudagit® E PO thermal treated at 90 °C, 8hr	1142-1183, 1236, 1267, 1385, 1461-1486, 1723, 2355, 2770, 2819, 2954, 3426
Ground Eudagit® E 100	1141-1185, 1238, 1268, 1386, 1454-1486, 1731, 2355, 2768, 2819, 2954, 3434
Physical mix (core pellets)	768, 797, 1105, 1240, 1267, 1397, 1450, 1579
Coated pellets	770, 797, 1105, 1240, 1267, 1397, 1452, 1579, **1729**

Table H3 The endotherm peaks of propranolol hydrochloride, Lactose and coated pellets

Formulations	Endotherm peaks of DSC (°C)
Propranolol hydrochloride	164.45
Lactose	149.4, 217.4
Physical mix (core pellets)	147.41, 163.66
Coated pellets	161.31

VITA

Mr. Chatuphon Charoenkitpaiboon was born on 30th January 1977, in Bangkok, Thailand. He graduated with the Bachelor of Science degree in Pharmacy in 1999 from the Faculty of Pharmaceutical Sciences, Mahidol University, Bangkok, Thailand. Following graduation, he worked as a pharmacist at Praram 9 Hospital, Thailand, for two years before attending the Master's Degree program in Pharmaceutical Sciences at Chulalongkorn University in 2001.