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APPENDICES

APPENDIX A

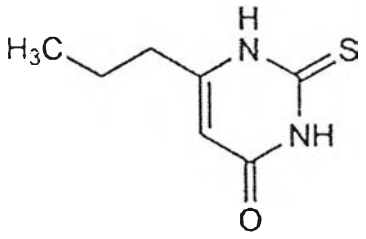
Molecular Structure and Physical Properties of Propylthiouracil (PTU)

(Aboul-Enein, 1977; Moffat, 2004)

1. Molecular structure

1.1 Empirical: $C_7H_{10}N_2OS$

1.2 Structural:



1.3 Molecular weight: 170.23

2. Physical properties

2.1 Melting range: 219-221 °C

2.2 Log P: 1.0

2.3 Solubiliy:

PTU is sparingly soluble in water (1:900 at 20 °C), soluble in 100 parts boiling water, in 60 parts of ethanol, in 60 parts of acetone, practically insoluble in ether, chloroform, benzene, freely soluble in aqueous solutions of ammonia and alkali hydroxide. A saturated aqueous solution is neutral or slightly acidic to litmus.

2.4 Ultraviolet spectrum:

PTU in neutral methanol absorbs ultraviolet radiation at 275 nm (a_m 15800) and at 214 nm (a_m 15600). In alkaline medium, it shows maxima at 315.5 nm (a_m 10900), 260 nm (a_m 10700) and at 207.5 nm (a_m 15400).

2.5 Stability:

PTU is a relatively stable compound at room temperature. It is recommended that it should be kept in a well-closed containers protected from light.

APPENDIX B

Molecular Structure and Physical Properties of Some Selected Materials

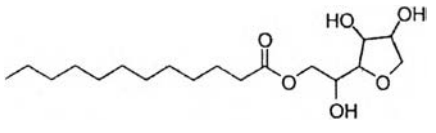
(Kibbe, 2000)

Properties of some selected materials

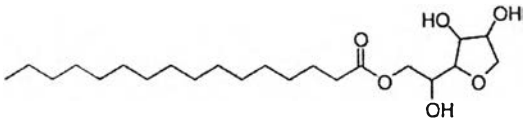
Material	Formula	Property
Cholesterol	$C_{27}H_{46}O$	MW: 386.67 MP: 147-150 °C BP: 360 °C
Span® 20	$C_{18}H_{34}O_6$	MW: 346 HLB: 8.6
Span® 40	$C_{22}H_{42}O_6$	MW:403 MP: 44-48 °C HLB: 6.7
Span® 60	$C_{24}H_{46}O_6$	MW: 431 MP: 53-57 °C HLB: 4.7
Brij® 52	$C_{22}H_{45}O_3$	MW: 357 MP: 33 °C HLB: 5.3
Brij® 76	$C_{38}H_{78}O_{11}$	MW: 710 MP: 38 °C HLB: 12.4
Solulan® C24	-	MW: 1,443 HLB: 8-9 Clound point: 88-95 °C
Glyceryl disterate	$C_{39}H_{76}O_5$	MW: 636 HLB: 2.4 MP:55-60 °C
Sucrose laurate ester (L-595)	-	HLB: 5.0
PEG-8-L	$C_{29}H_{58}O_{10}$	MW: 552 HLB: 13.0 MP: 12 °C

The structure of Span® 20, Span® 40, Span® 60, Brij® 52, Brij® 76, Solulan® C24, GDS, sucrose laurate ester, and PEG-8-L

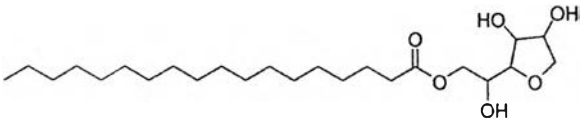
1. Span® 20



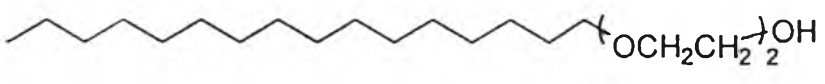
2. Span® 40



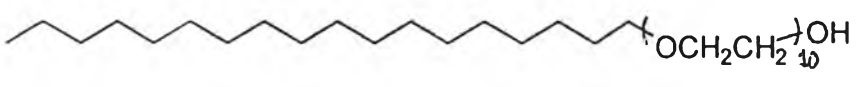
3. Span® 60



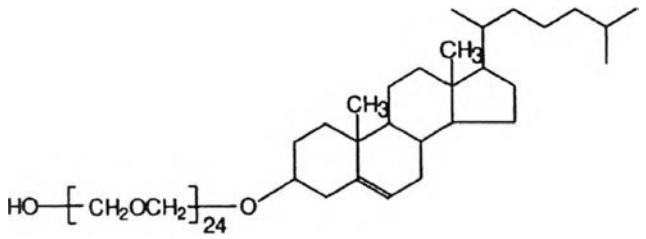
4. Brij® 52



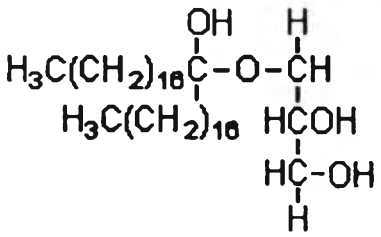
5. Brij® 76



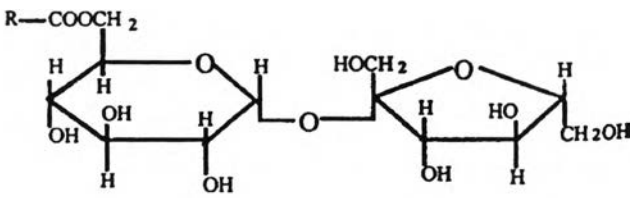
6. Solulan® C24



7. Glyceryl distearate (GDS)

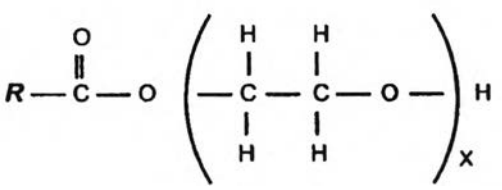


8. sucrose laurate ester



R = C_{12}

9. PEG-8-L



R = C_{12} and X = 8

APPENDIX C

Validation of UV Spectroscopic Method

(The United States Pharmacopieal Convention, 2002)

Validation for the Quantitative Determination of PTU in Isopropanol by UV Spectroscopy

1. Specificity

Under the UV absorption spectrophotometric method used, the absorbance of PTU must not be interfered by the absorbance of other components in the sample. The blank vesicular suspension (without PTU) and PTU vesicular suspension were prepared. The UV spectrum from UV spectrophotometer of the blank vesicular suspension was compared with the spectra of the PTU vesicular suspension.

2. Linearity

Eight standard solutions of PTU ranging 1.0 to10.0 μg/mL were prepared and analyzed. Linear regression analysis of the absorbance versus their concentrations was performed. The linearity was determined from the coefficient of determination.

3. Accuracy

PTU at 2.5, 5.5 and 8.5 μg/mL and surfactant/cholesterol mixtures 100 mg/mL were prepared. Three sets of each concentration were prepared. Each individual sample was analyzed by UV spectrophotometry at 275 nm, and percent analytical recovery of each sample was calculated.

4. Precision

4.1 Within run precision

The within run precision was evaluated by analyzing six sets of the three standard solutions of PTU in six intervals of time in the same day. The mean, standard deviation (SD) and the coefficient of variation (%CV) of each standard solution were determined.

4.2 Between run precision

The between run precision was evaluated by comparing each concentration of five sets of standard solutions were prepared and analyzed in different days. The mean, standard deviation (SD) and the coefficient of variation (%CV) of each standard solution were determined.

Validation for the Quantitative Determination of PTU Solution in Isopropanol by UV Spectrophotometry

The validation of the analytical method is the process by which performance characteristics of the method are established to meet the requirements for the intended analytical parameters. The analytical parameters used for the assay validation were specificity, linearity, accuracy and precision.

1. Specificity

The specificity of an analytical method is its ability to measure the given analyte accurately and specificity in the presence of other components in the sample. The UV absorption spectra (Fingure C1-C16) indicated that the wavelength 275 nm was the optimal wavelength giving the highest sensitivity without interference of surfactants, cholesterol and Solulan® C24 which showed no absorbance at the wavelength 200-400 nm.

2. Linearity

The linearity of an analytical method is its ability to elicit test results that are directly or by a well-defined mathematical transformation, proportional to the concentration of the analyte in samples within a given range. The linearity is usually expressed in term of the variance around the slope of the regression line calculated according to an established mathematical relationship from test results obtained by the analysis of samples with varying concentrations of analyte.

The standard curves of PTU in water and phosphate buffer pH 7.4 diluted with isopropanol were shown in Fingures C17 and C18, respectively. The standard curves were found to be linear with coefficient of determination 0.9999 and 0.9999, respectively. These results indicated that UV spectrophotometric method was acceptable for quantitative analysis of PTU in the range studied. The equations of standard curves according to Beer's Law were used for calculating the concentration of PTU.

3. Accuracy

The accuracy of an analytical method is the closeness of test results obtained by the method to the true value. Accuracy may often be expressed as percent recovery by the assay of known, added amount of analyte. The percentages of analytical recovery of

each PTU concentration in water and phosphate buffer pH 7.4 are shown in Table C1 and C2. All the percentage analytical recovery of all drug concentrations in water with a mean of and a %CV of, and in phosphate buffer pH 7.4 with a mean of and a %CV of, indicated the high accuracy of this method. Thus, it could be used for analysis of PTU in all concentrations used.

4. Precision

The precision of an analytical method is the degree of agreement among individual test results when the procedure is applied repeatedly to multiple samplings of a homogeneous sample. The precision of an analytical method is usually expressed as the standard deviation or relative standard deviation (coefficient of variation).

The precision of the analysis of PTU in water and phosphate buffer pH 7.4 by UV spectrophotometric method was determined both within run precision and between run precision as illustrated in Tables C3-C6. All percentage coefficient of variation values were lower than 2.00%, indicating that of the UV spectrophotometric method used were precise for quantitative analysis of PTU in the range studied.

In conclusion, the analysis of PTU in water and phosphate buffer pH 7.4 by UV spectrophotometric method developed in this study showed good specificity, linearity, accuracy and precision. Thus this method was used for determination of the content of PTU.

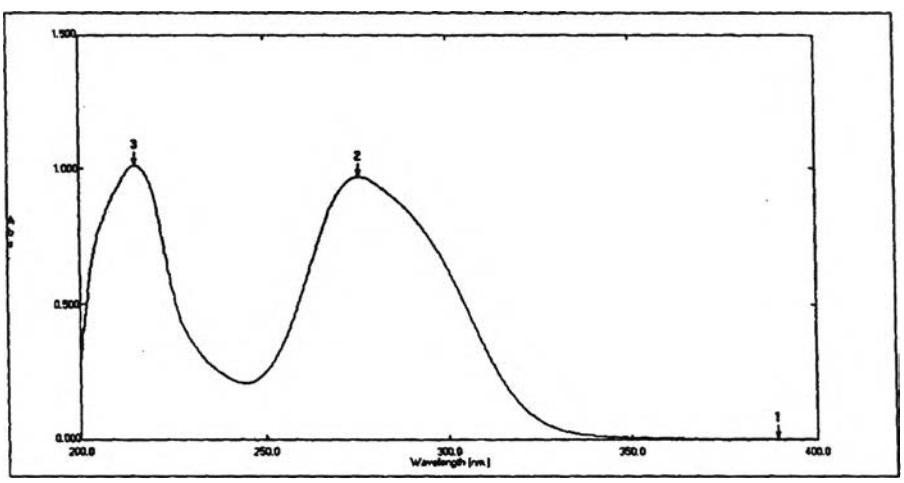


Figure C1 Absorption spectrum of PTU in water diluted with isopropanol

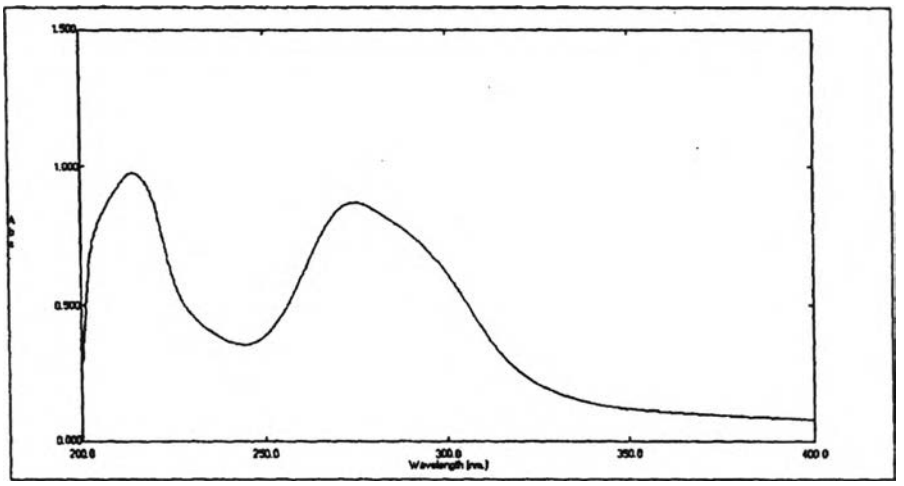


Figure C2 Absorption spectrum of PTU in phosphate buffer pH 7.4 diluted with isopropanol

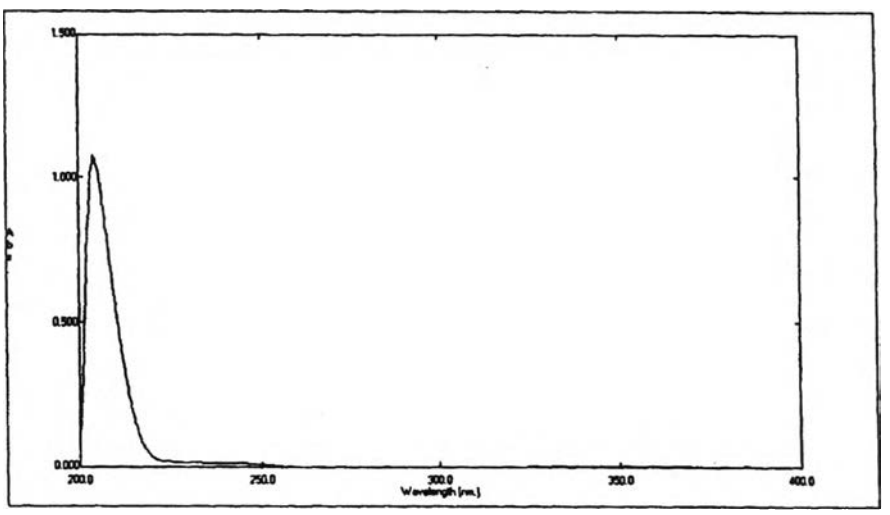


Figure C3 Absorption spectrum of Brij® 52:CHO:Solulan® C24 without PTU in water diluted with isopropanol

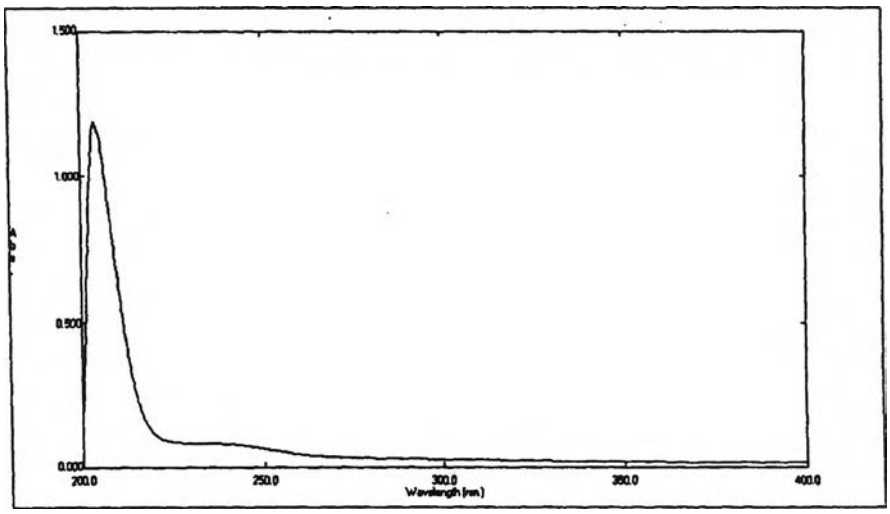


Figure C4 Absorption spectrum of Brij® 52:CHO:Solulan® C24 without PTU in phosphate buffer pH 7.4 diluted with isopropanol

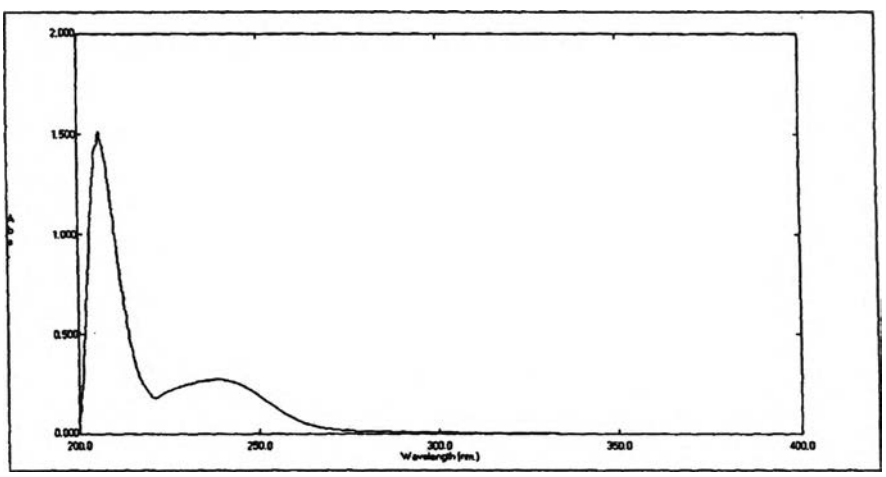


Figure C5 Absorption spectrum of Brij® 76:CHO:Solulan® C24 without PTU in water diluted with isopropanol

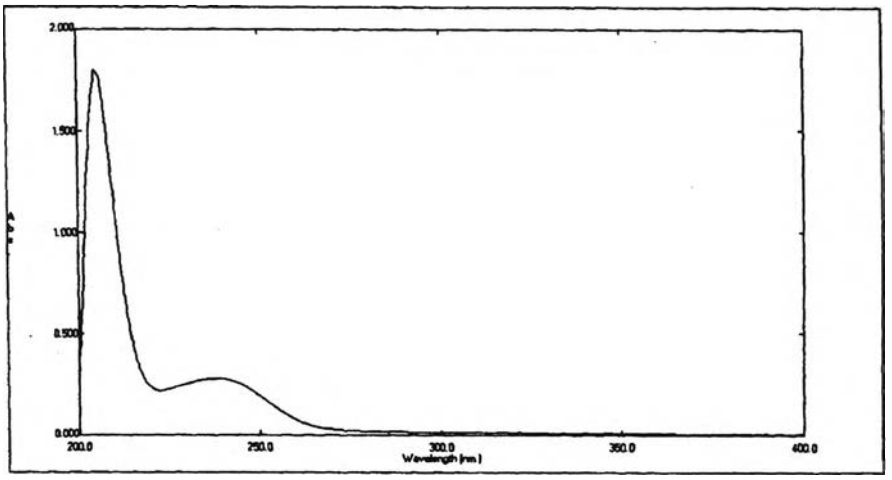


Figure C6 Absorption spectrum of Brij® 76:CHO:Solulan® C24 without PTU in phosphate buffer pH 7.4 diluted with isopropanol

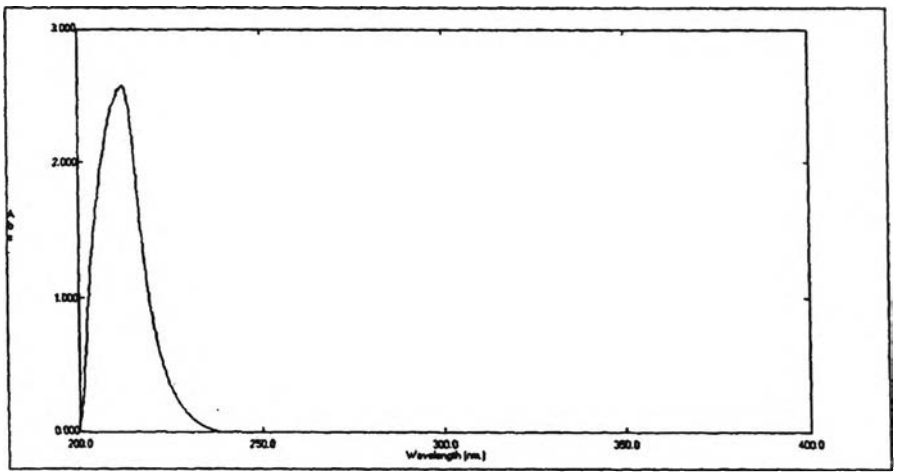


Figure C7 Absorption spectrum of GDS:CHO:Brij® 76 without PTU in water diluted with isopropanol

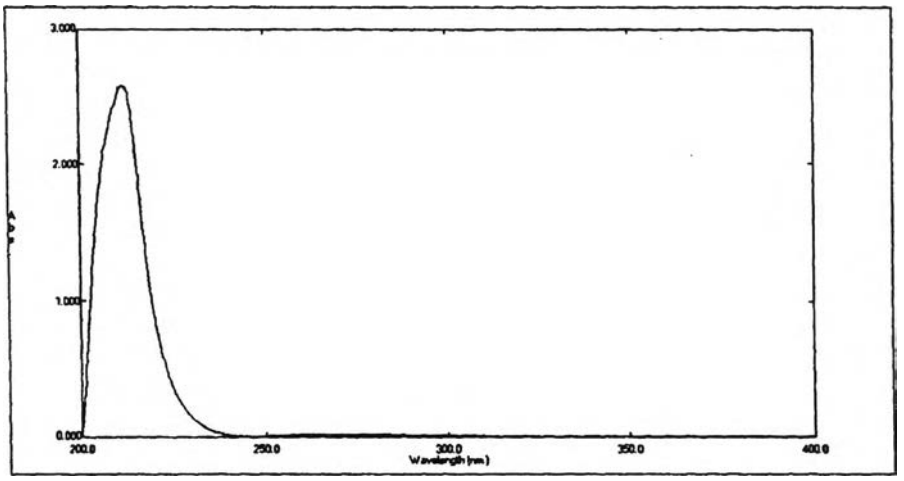


Figure C8 Absorption spectrum of GDS:CHO:Brij® 76 without PTU in phosphate buffer pH 7.4 diluted with isopropanol

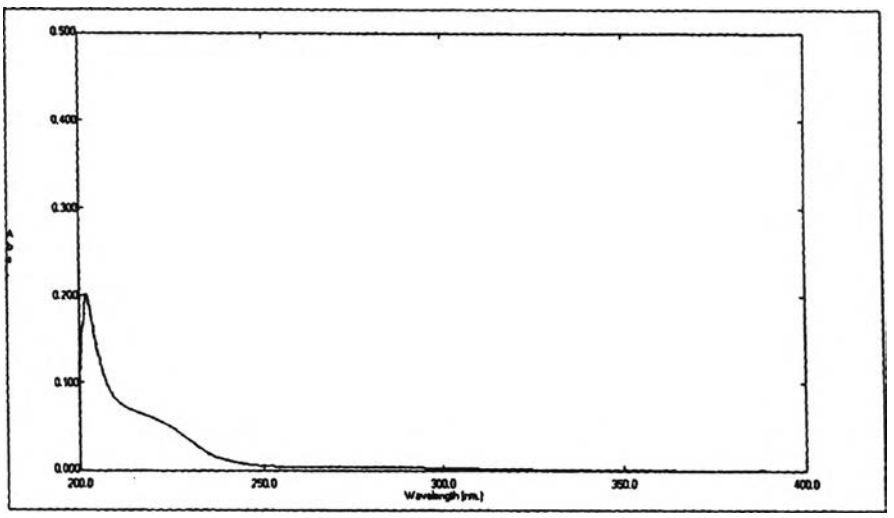


Figure C9 Absorption spectrum of L-595:PEG-8-L without PTU in water diluted with isopropanol

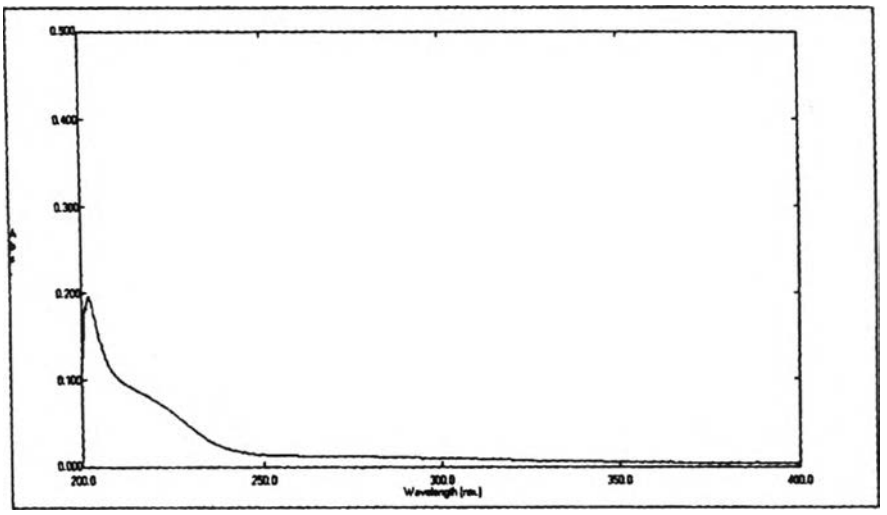


Figure C10 Absorption spectrum of L-595:PEG-8-L without PTU in phosphate buffer pH 7.4 diluted with isopropanol

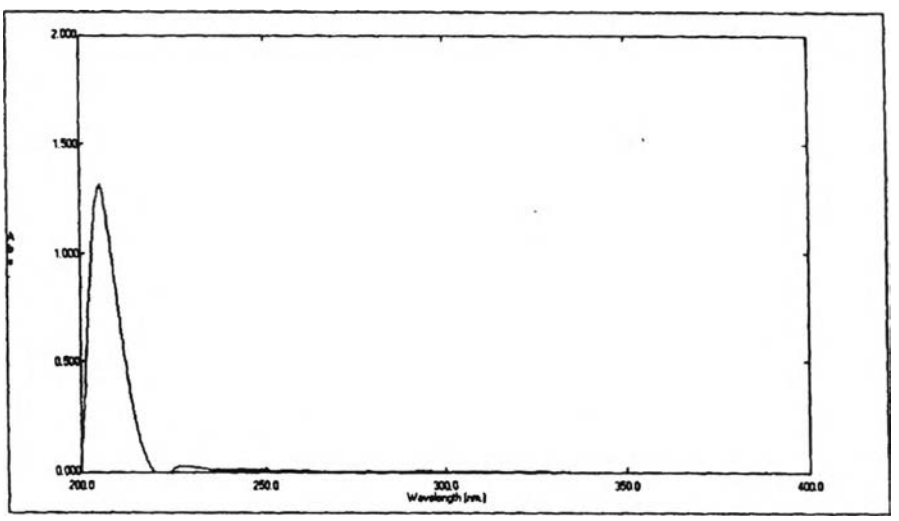


Figure C11 Absorption spectrum of Span® 20:CHO:Solulan® C24 without PTU in water diluted with isopropanol

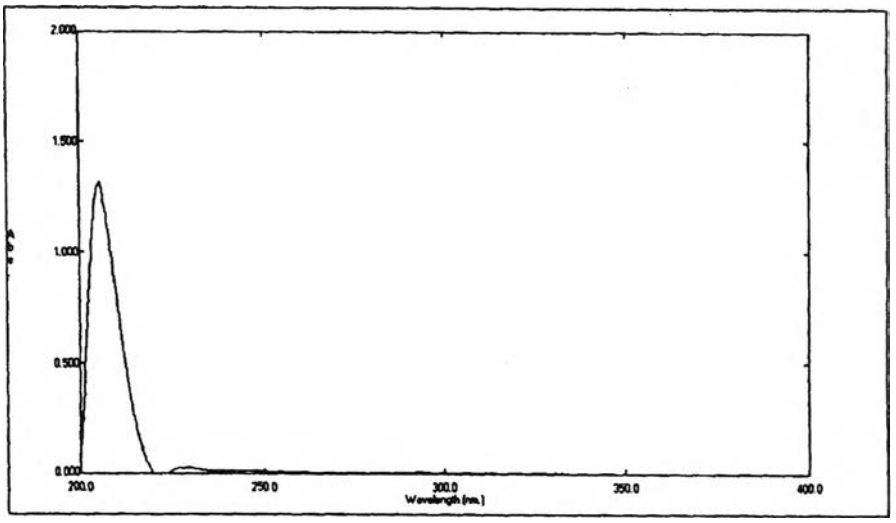


Figure C12 Absorption spectrum of Span® 20:CHO:Solulan® C24 without PTU in phosphate buffer pH 7.4 diluted with isopropanol

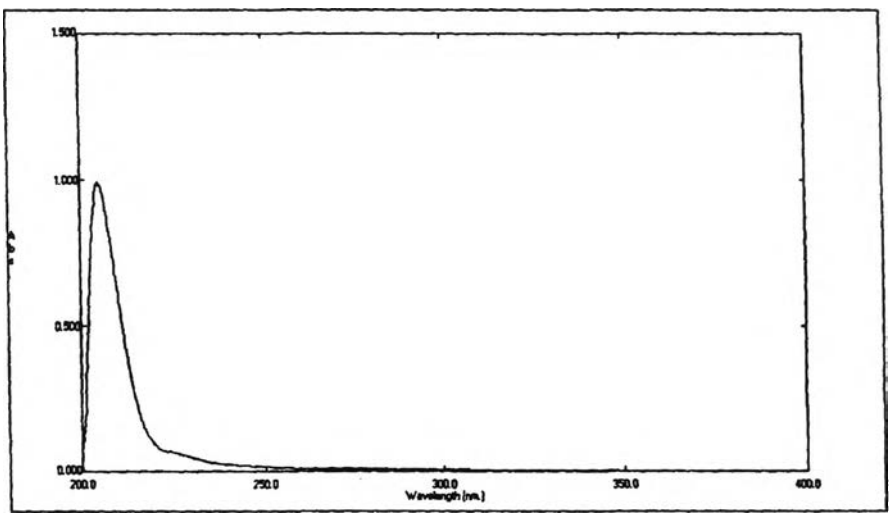


Figure C13 Absorption spectrum of Span® 40:CHO:Solulan® C24 without PTU in water diluted with isopropanol

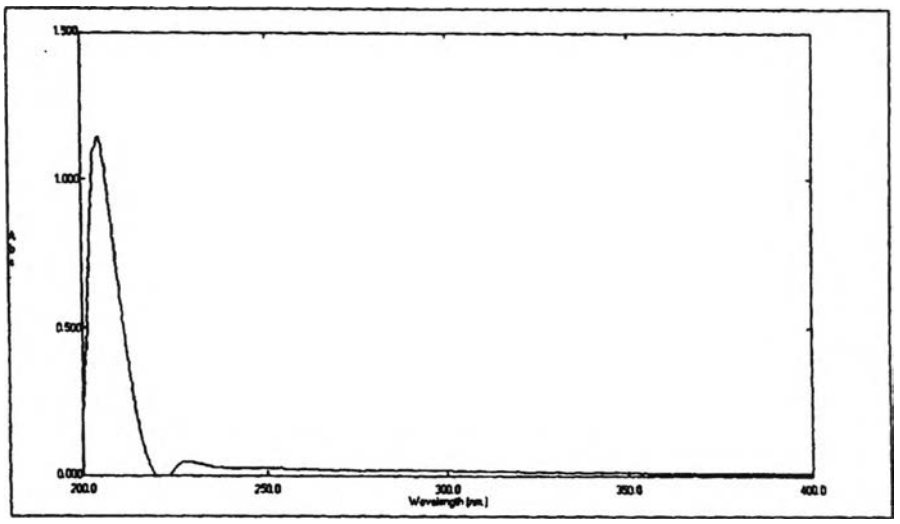


Figure C14 Absorption spectrum of Span® 40:CHO:Solulan® C24 without PTU in phosphate buffer pH 7.4 diluted with isopropanol

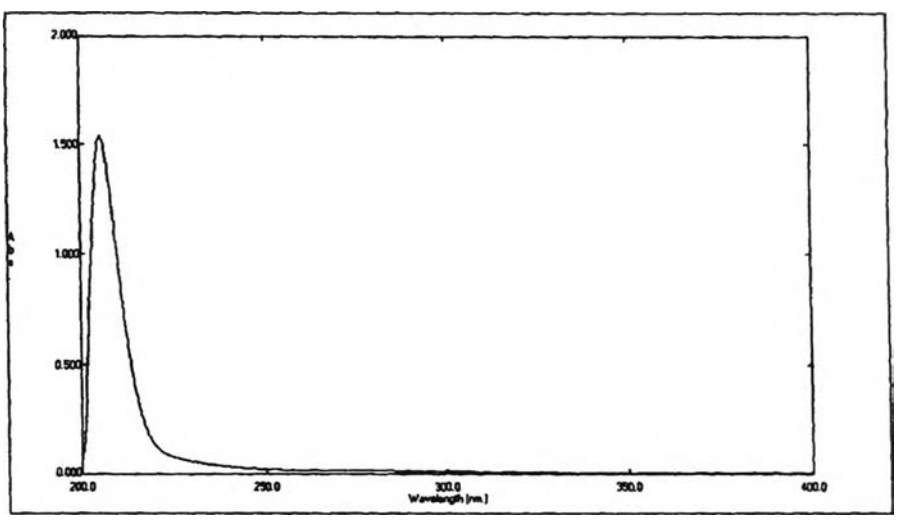


Figure C15 Absorption spectrum of Span® 60:CHO:Solulan® C24 without PTU in water diluted with isopropanol

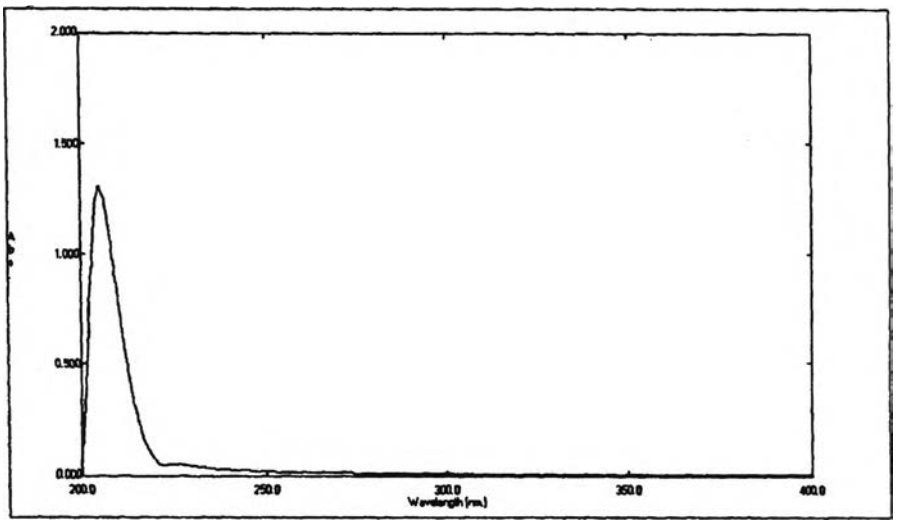
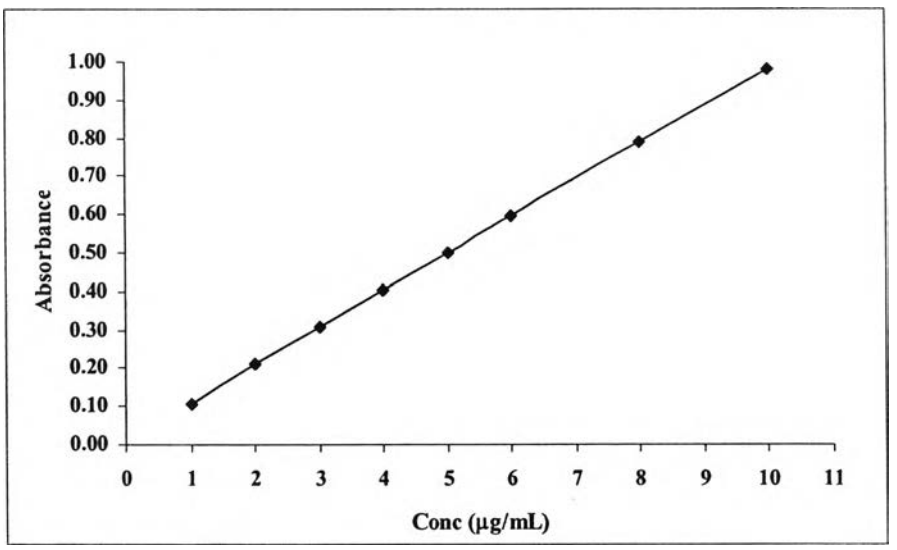


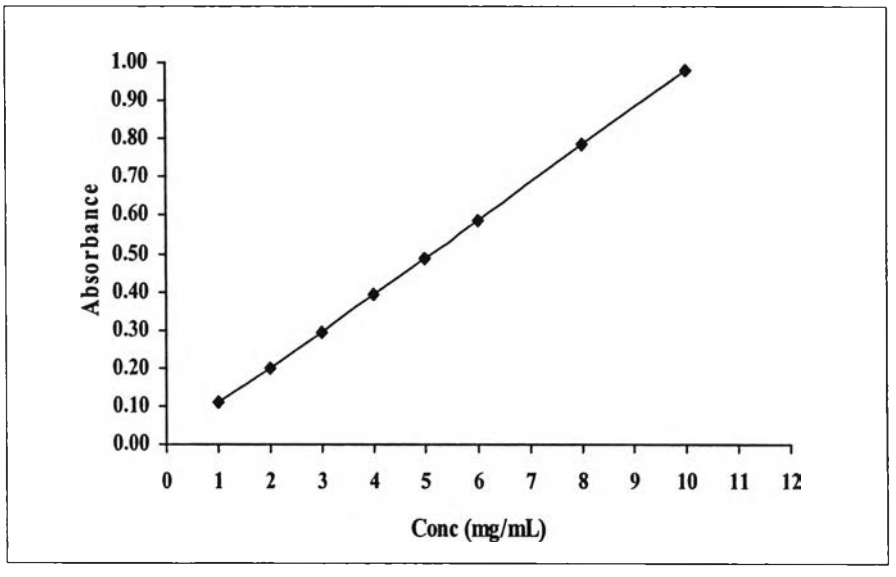
Figure C16 Absorption spectrum of Span® 60:CHO:Solulan® C24 without PTU in phosphate buffer pH 7.4 diluted with isopropanol



FigureC 17 A representative of standard curve of standard solution of PTU in water diluted with isopropanol

Where $y = 0.0157 + 0.0967x$; $r^2 = 0.9999$

y = absorbance, x = PTU concentration (µg/mL)



FigureC 18 A representative of standard curve of standard solution of PTU in phosphate buffer pH 7.4 diluted with isopropanol

Where $y = 0.0046 + 0.0972x$; $r^2 = 0.9999$

y = absorbance, x = PTU concentration (μg/mL)

Table C1 The percentages of analytical recovery of PTU in water diluted with isopropanol by UV spectrophotometric method

Actual concentration of PTU (μg/mL)	Calculated concentration of PTU (μg/mL)	% Analytical recovery
2.50	2.48	99.20
	2.48	99.20
	2.48	99.20
	2.57	102.80
	2.47	98.80
	2.47	98.80
5.50	5.48	99.64
	5.48	99.64
	5.36	97.45
	5.59	101.64
	5.38	97.82
	5.38	97.82
8.50	8.56	100.71
	8.51	100.12
	8.36	98.35
	8.76	103.06
	8.38	98.56
	8.43	99.18

Mean % Recovery = 99.56

SD = 1.60

%CV = 1.60

Table C2 The percentages of analytical recovery of PTU in phosphate buffer pH 7.4 diluted with isopropanol by UV spectrophotometric method

Actual concentration of PTU (μg/mL)	Calculated concentration of PTU (μg/mL)	% Analytical recovery
2.50	2.50	100.00
	2.52	100.80
	2.44	97.60
	2.41	97.40
	2.46	98.40
	2.44	97.60
5.50	5.72	104.00
	5.62	102.18
	5.55	100.91
	5.40	98.18
	5.66	102.91
	5.55	100.91
8.50	8.55	100.59
	8.49	99.88
	8.33	98.00
	8.53	100.35
	8.49	99.88
	8.46	99.53

Mean % Recovery = 99.95

SD = 1.88

%CV = 1.89

Table C3 The within run precision of PTU in water diluted with isopropanol by UV spectrophotometric method

Conc.(μg/mL)	Calculated Conc.(μg/mL)						Mean	SD	%CV
	1	2	3	4	5	6			
2.50	2.4536	2.4089	2.4313	2.4031	2.3978	2.4219	2.4644	0.0182	0.74
5.50	5.7397	5.6592	5.5821	5.4369	5.6939	5.5821	5.6157	0.1073	1.91
8.50	8.5705	8.5388	8.3777	8.3909	8.5488	8.3560	8.4638	0.0986	1.16

Table C4 The within run precision of PTU in phosphate buffer pH 7.4 diluted with isopropanol by UV spectrophotometric method

Conc.(μg/mL)	Calculated Conc.(μg/mL)						Mean	SD	%CV
	1	2	3	4	5	6			
2.50	2.5295	2.4934	2.4728	2.5429	2.4388	2.5408	2.5030	0.0421	1.68
5.50	5.4902	5.4794	5.3959	5.4866	5.4794	5.4143	5.4576	0.413	0.76
8.50	8.6406	8.6290	8.6060	8.4908	8.3954	8.3834	8.5242	0.1173	1.38

Table C5 The between run precision of PTU in water diluted with isopropanol by UV spectrophotometric method

Conc.(μg/mL)	Calculated Conc.(μg/mL)					Mean	SD	%CV
	Day1	Day2	Day3	Day4	Day5			
2.50	2.5009	2.4644	2.5115	2.4557	2.4867	2.4838	0.0236	0.95
5.50	5.4466	5.6157	5.4608	5.5377	5.5158	5.5153	0.0676	1.23
8.50	8.4663	8.4638	8.4908	8.5322	8.5341	8.4974	0.0343	0.40

Table C6 The between run precision of PTU in phosphate buffer pH 7.4 diluted with isopropanol by UV spectrophotometric method

Conc(μg/mL)	Calculated Conc.(μg/mL)					Mean	SD	%CV
	Day1	Day2	Day3	Day4	Day5			
2.50	2.4617	2.5030	2.4885	2.4829	2.5104	2.4893	0.0189	0.76
5.50	5.5818	5.4576	5.4693	5.5093	5.5680	5.5172	0.0563	1.02
8.50	8.4721	8.5242	8.5095	8.6293	8.6633	8.5597	0.0822	0.96

APPENDIX D

Validation of HPLC Method

(The United States Pharmacopieal Convention, 2002)

Validation for the Quantitative Determination of PTU in PBS pH 7.4 Solution by HPLC Method

1. Specificity

Under the HPLC method used, the peak chromatogram of PTU must not be interfered by the peak chromatogram of other components in the sample. The blank vesicular suspension (without PTU) and PTU vesicular suspension were prepared. The chromatogram of the blank vesicular suspension was compared with chromatogram of the PTU vesicular suspension.

2. Linearity

Eight standard solutions of PTU ranging of 0.05 to10.0 μg/mL for PBS system and 0.10 to 10.0 μg/mL for methanol system, were prepared and analyzed. Linear regression analysis of the absorbance versus their concentrations was performed. The linearity was determined from the coefficient of determination.

3. Accuracy

PTU at 0.15, 5.0 and 8.5 μg/mL for PBS system and 0.30, 5.0 and 8.5 μg/mL and surfactant/cholesterol mixtures 100 mg/mL were prepared. Three sets of each concentration were prepared. Each individual sample was analyzed by HPLC method, and percent analytical recovery of each sample was calculated.

4. Precision

4.1 Within run precision

The within run precision was evaluated by analyzing six sets of the three standard solutions of PTU in six intervals of time in the same day. The mean, standard deviation (SD) and the coefficient of variation (%CV) of each standard solution were determined.

4.2 Between run precision

The between run precision was evaluated by comparing each concentration of five sets of standard solutions were prepared and analyzed in different days. The mean, standard deviation (SD) and the coefficient of variation (%CV) of each standard solution were determined.

Validation for the Quantitative Determination of PTU in PBS pH 7.4 Solution by HPLC Method

The validation of the analytical method is the process by which performance characteristics of the method are established to meet the requirements for the intended analytical parameters. The analytical parameters used for the assay validation were specificity, linearity, accuracy and precision.

1.Specificity

The specificity of an analytical method is its ability to measure the given analyte accurately and specificity in the presence of other components in the sample. The chromatograms (Figure D1-D8) indicated that the conditions used was the optimal condition giving the highest sensitivity without interference of surfactants, cholesterol and Solulan® C24 which showed no peak chromatograms at the peak of internal standard and PTU. The retention time of PTU and theophylline were about 5.1 and 8.9, respectively. Thus these two peaks were completely separated from each other.

2.Linearity

The linearity of an analytical method is its ability to elicit test results that are directly or by a well-defined mathematical transformation, proportional to the concentration of the analyte in samples within a given range. The linearity is usually expressed in term of the variance around the slope of the regression line calculated according to an established mathematical relationship from test results obtained by the analysis of samples with varying concentrations of analyte.

The standard curves of PTU solution diluted with PBS and methanol were shown in Figures D9-D10, respectively. The standard curves were found to be linear with coefficient of determination 0.9999 and 0.9999, respectively. These results indicated that HPLC method was acceptable for quantitative analysis of PTU in the range studied. The equations of standard curves according to Beer's Law were used for calculating the concentration of PTU.

3. Accuracy

The accuracy of an analytical method is the closeness of test results obtained by the method to the true value. Accuracy may often be expressed as percent recovery by

the assay of known, added amount of analyte. The percentages of analytical recovery of each PTU concentration in PBS and methanol are shown in Table D1 and D2. All the percentage analytical recovery of all drug concentrations in water with a mean of and a %CV of, and in phosphate buffer pH 7.4 with a mean of and a %CV of, indicated the high accuracy of this method. Thus, it could be used for analysis of PTU in all concentrations used.

4. Precision

The precision of an analytical method is the degree of agreement among individual test results when the procedure is applied repeatedly to multiple samplings of a homogeneous sample. The precision of an analytical method is usually expressed as the standard deviation or relative standard deviation (coefficient of variation).

The precision of the analysis of PTU in PBS and methanol by HPLC method was determined both within run precision and between run precision as illustrated in Tables D3-D6. All percentage coefficient of variation values were lower than 2.00%, indicating that of the UV spectrophotometric method used were precise for quantitative analysis of PTU in the range studied.

In conclusion, the analysis of PTU in water PBS and methanol by HPLC method method developed in this study showed good specificity, linearity, accuracy and precision. Thus this method was used for determination of the content of PTU.

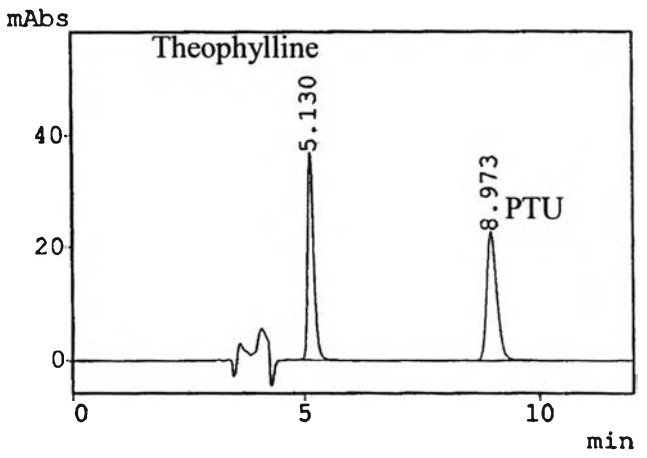


Figure D1 HPLC chromatogram of PTU (3.0 μg/mL) and theophylline (5.0 μg/mL) in methanol

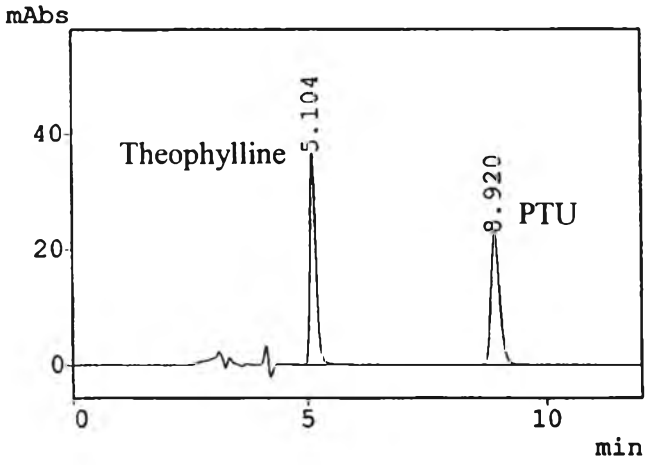


Figure D2 HPLC chromatogram of PTU (3.0 μg/mL) and theophylline (5.0 μg/mL)in PBS

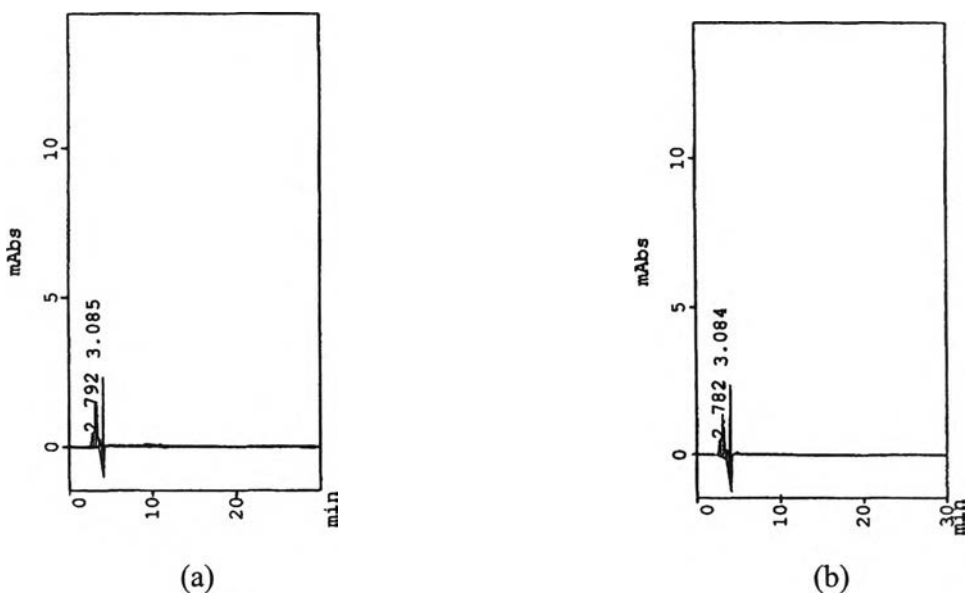


Figure D3 HPLC chromatogram of (a) = GDS:CHO:Brij® 76 in PBS
(b) = L-595:PEG-8-L in PBS

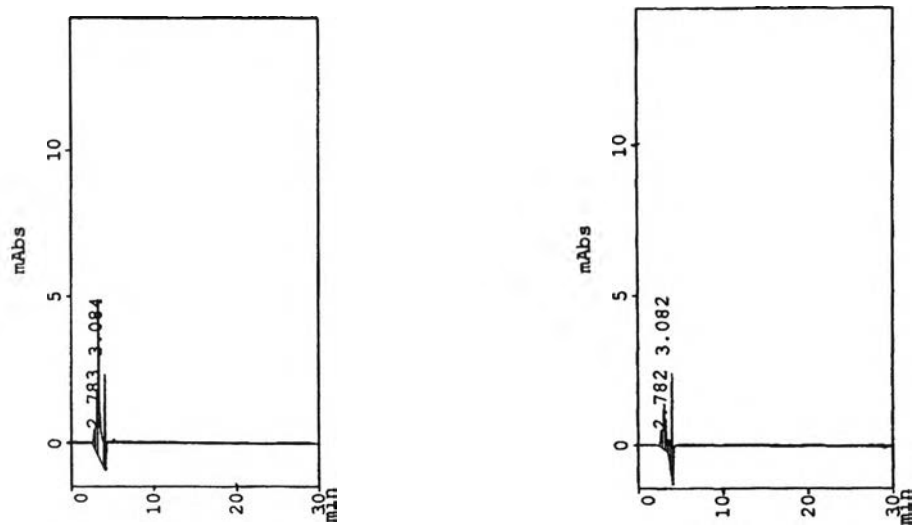


Figure D4 HPLC chromatogram of (a) = Span® 40:CHO:Solulan® C24 in PBS
(b) = Span® 20:CHO:Solulan® C24 in PBS

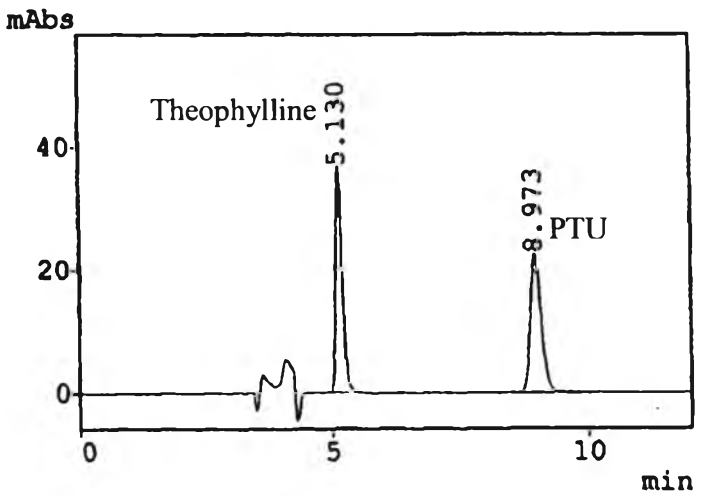


Figure D5 HPLC chromatogram of PTU (3.0 μg/mL) and theophylline (5.0 μg/mL) in GDS:CHO:Brij® 76 in methanol

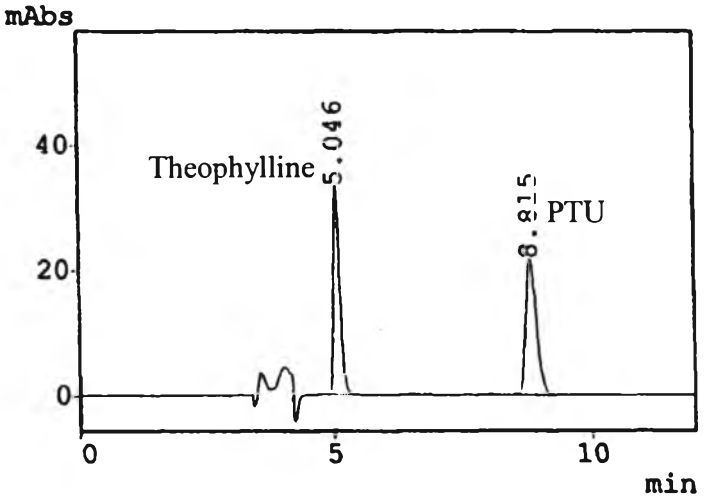


Figure D6 HPLC chromatogram of PTU (3.0 μg/mL) and theophylline (5.0 μg/mL) in L-595:PEG-8-L in methanol

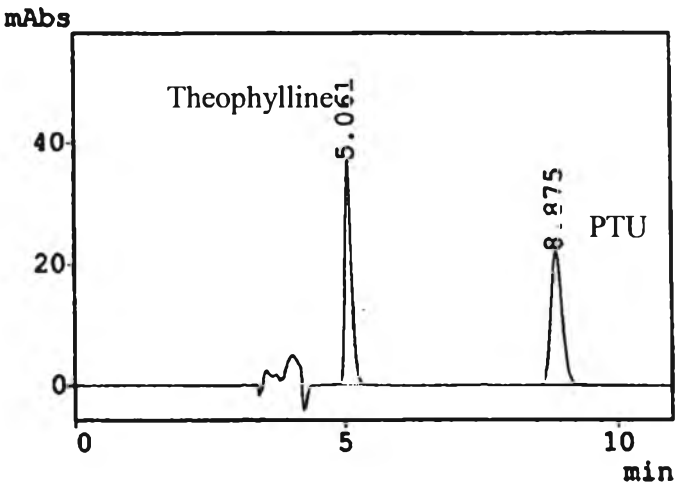


Figure D7 HPLC chromatogram of PTU (3.0 μg/mL) and theophylline (5.0 μg/mL) in Span® 40:CHO:Solulan® C24 in methanol

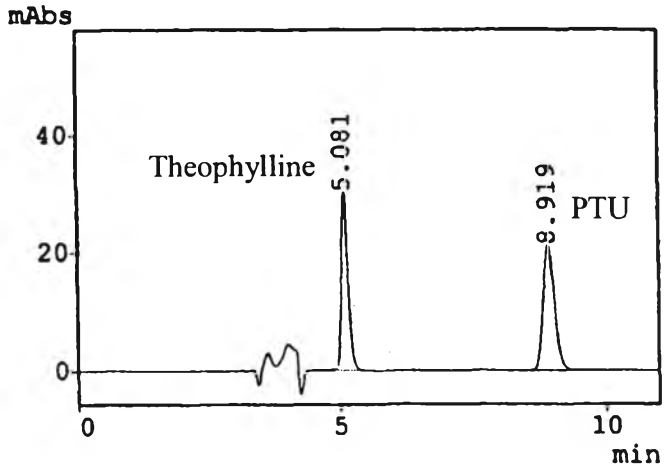


Figure D8 HPLC chromatogram of PTU (3.0 μg/mL) and theophylline (5.0 μg/mL) in Span® 20:CHO:Solulan® C24 in methanol

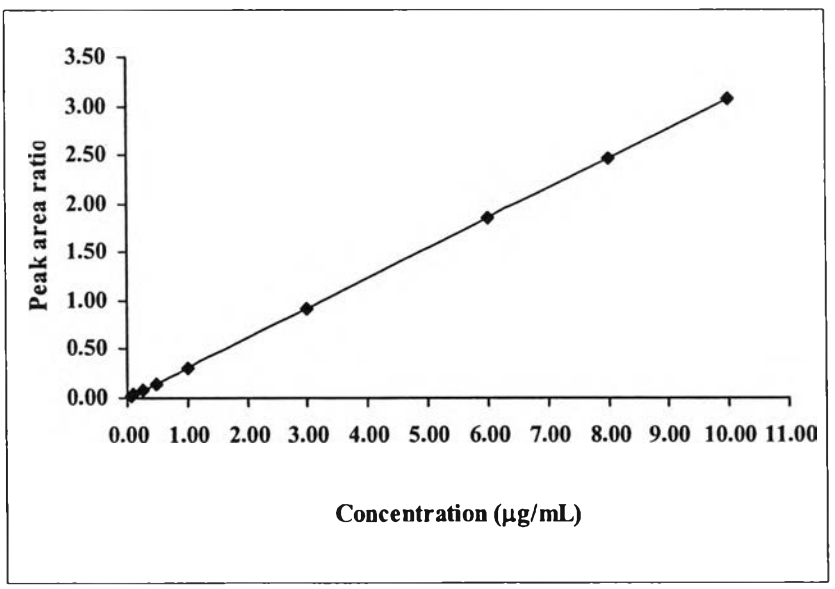


Figure D9 A representative of standard curve of standard solution of PTU diluted with PBS

Where $y = 0.3083x - 0.0024$; $r^2 = 0.9999$

y = absorbance, x = PTU concentration (μg/mL)

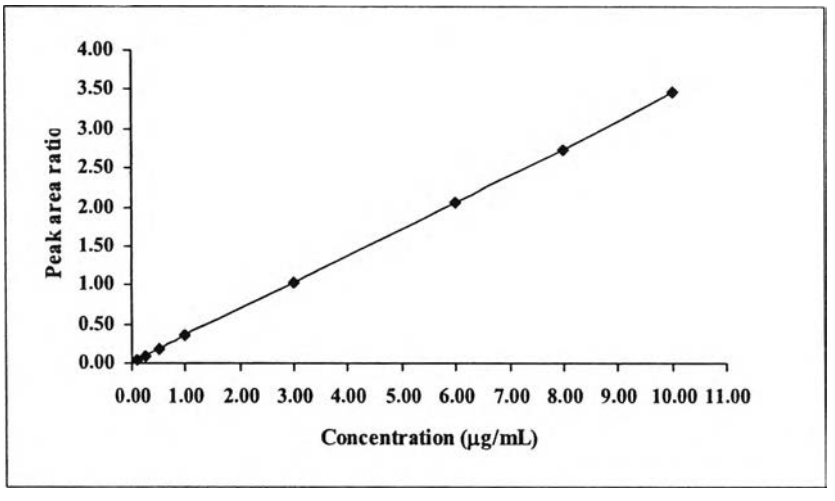


Figure D10 A representative of standard curve of standard solution of PTU diluted with methanol

Where $y = 0.3432x + 0.0062$; $r^2 = 0.9999$

y = absorbance, x = PTU concentration (µg/mL)

Table D1 The percentages of analytical recovery of PTU in water diluted with PBS pH 7.4

Actual concentration of PTU (μg/mL)	Calculated concentration of PTU (μg/mL)	% Analytical recovery
0.15	0.153	101.96
	0.152	101.17
	0.153	101.20
	0.149	99.03
	0.154	102.37
	0.147	97.82
5.00	4.921	98.41
	4.949	98.98
	5.015	100.29
	4.994	99.88
	4.970	99.40
	4.991	99.82
8.50	8.399	98.81
	8.542	100.49
	8.564	100.75
	8.417	99.03
	8.454	99.46
	8.485	99.82

Mean % Recovery = 99.92

SD = 1.22

%CV = 1.22

Table D2 The percentages of analytical recovery of PTU diluted with methanol

Actual concentration of PTU (μg/mL)	Calculated concentration of PTU (μg/mL)	% Analytical recovery
0.30	0.306	101.83
	0.294	98.05
	0.298	99.34
	0.297	99.07
	0.296	98.55
	0.305	101.66
5.00	5.028	100.55
	4.945	98.90
	4.935	98.70
	4.998	99.96
	5.033	100.6
	5.012	100.25
8.50	8.551	100.60
	8.469	99.64
	8.641	101.66
	8.349	98.22
	8.670	102.01
	8.380	98.59

Mean % Recovery = 99.90

SD = 1.31

%CV = 1.31

Table D3 The within run precision of PTU diluted with PBS pH 7.4 by HPLC method

Conc.(μg/mL)	Calculated Conc.(μg/mL)						Mean	SD	%CV
	1	2	3	4	5	6			
0.15	0.1499	0.1514	0.1501	0.1467	0.1498	0.1479	0.1493	0.0017	1.12
5.00	5.1065	5.2126	5.0555	5.0502	5.0583	5.0877	5.0952	0.0615	1.21
8.50	8.6389	8.6476	8.3157	8.6187	8.6151	8.5864	8.5704	0.1266	1.48

Table D4 The within run precision of PTU diluted with methanol by HPLC method

Conc.(μg/mL)	Calculated Conc.(μg/mL)						Mean	SD	%CV
	1	2	3	4	5	6			
0.30	0.3055	0.3051	0.3000	0.3037	0.3055	0.2992	0.3028	0.0032	1.06
5.00	5.0276	4.9913	4.9756	4.9955	5.0753	5.0920	5.0543	0.0516	1.02
8.50	8.5509	8.4721	8.5228	8.4638	8.4663	8.5720	8.5007	0.0618	0.73

Table D5 The between run precision of PTU diluted with PBS pH 7.4 by HPLC method

Conc.(μg/mL)	Calculated Conc.(μg/mL)					Mean	SD	%CV
	Day1	Day2	Day3	Day4	Day5			
0.15	0.1491	0.1510	0.1521	0.1499	0.1485	0.1501	0.0014	0.96
5.00	5.0100	4.9769	4.9290	5.0570	4.9938	4.99933	0.0468	0.94
8.50	8.3529	8.3667	8.5486	8.3358	8.3297	8.3867	0.916	1.09

Table D6 The between run precision of PTU diluted with methanol by HPLC method

Conc(μg/mL)	Calculated Conc.(μg/mL)					Mean	SD	%CV
	Day1	Day2	Day3	Day4	Day5			
0.30	0.2980	0.2972	0.3028	0.2949	0.3038	0.2993	0.0038	1.26
5.50	4.9348	4.9981	4.9830	4.9349	4.9567	4.9615	0.0285	0.57
8.50	8.6413	8.3486	8.5227	8.6478	8.6582	8.5637	0.1323	1.54

Appendix E

Photographs of PTU Niosomes

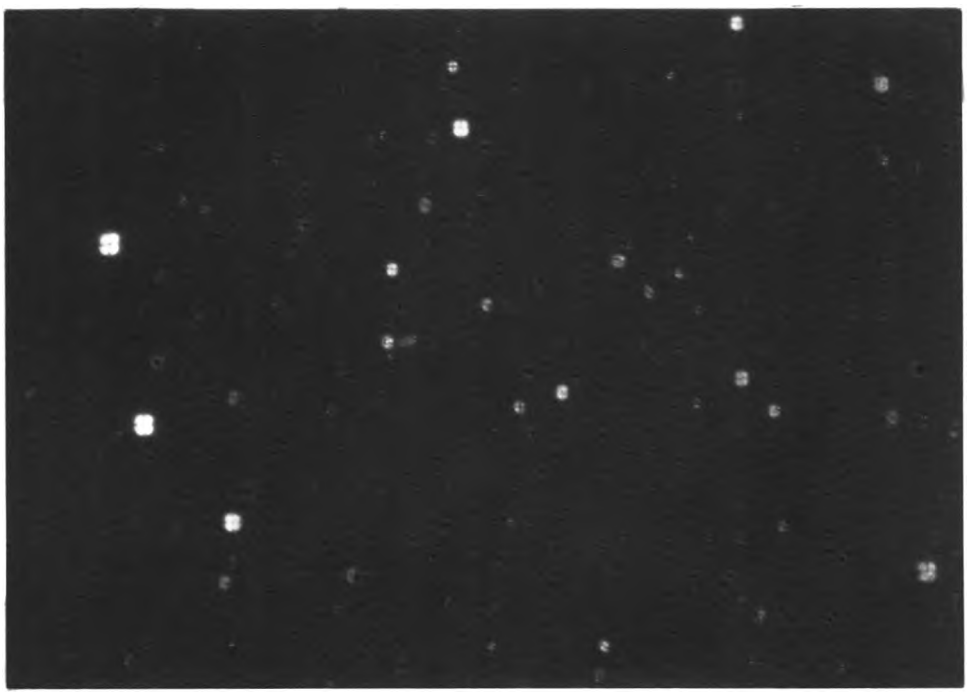


Figure E1 Polarized-light microscopic image of the Span® 20:CHO:Solulan® C-24 vesicles (x 400)

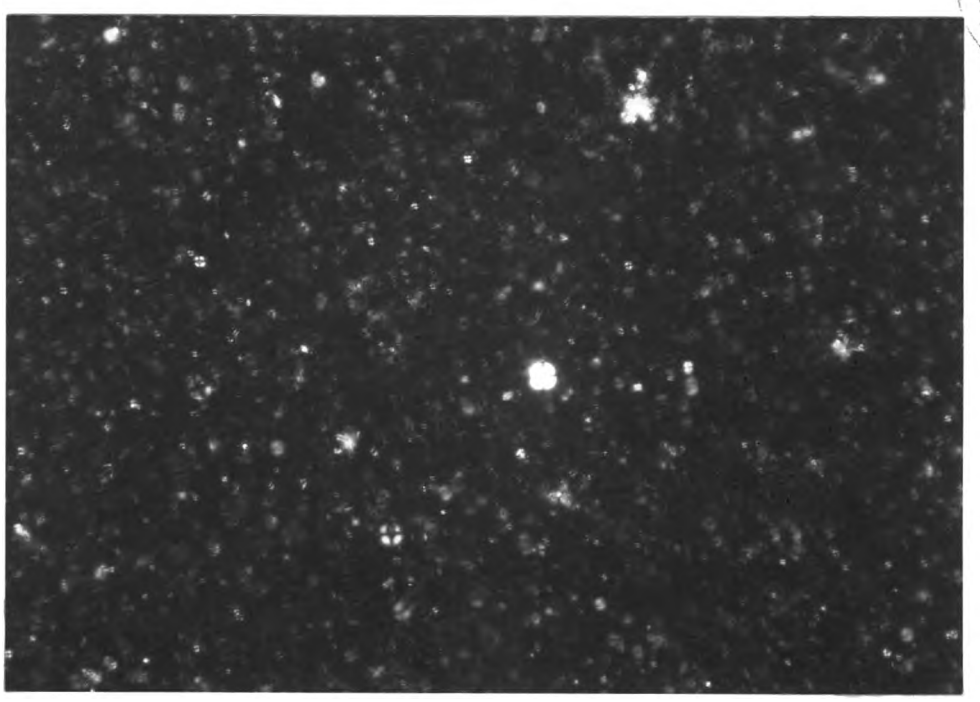


Figure E2 Polarized-light microscopic image of the Span® 40:CHO:Solulan® C-24 vesicles (x 400)

Figure E3 Polarized-light microscopic image of the GDS:CHO:Brij® 76 vesicles (x 400)

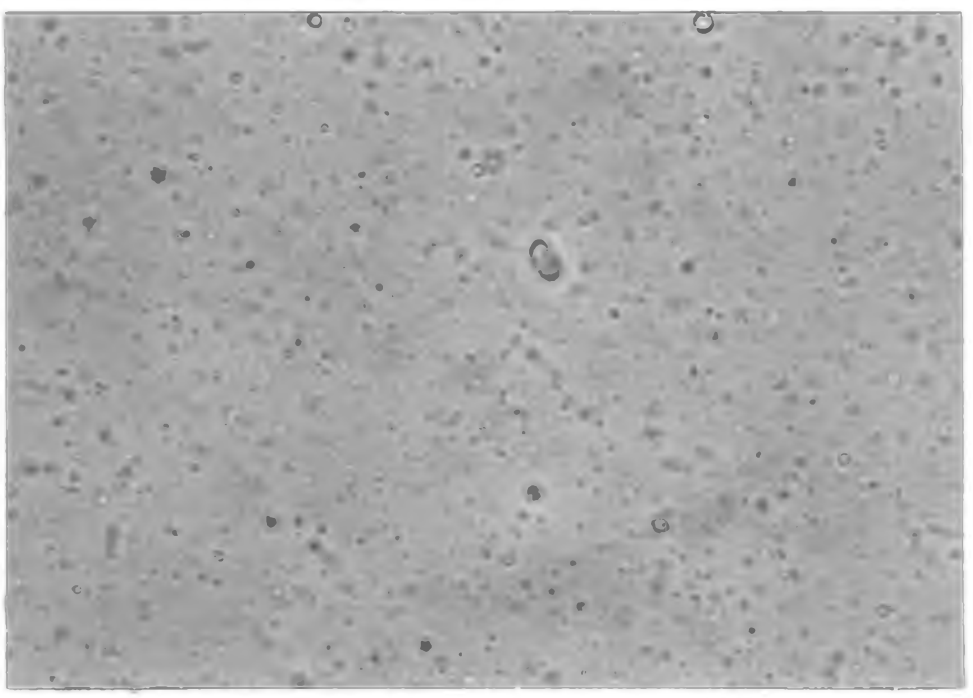


Figure E4 Photograph of niosomes prepared by Span® 20:CHO:Solulan® C-24 vesicles (x 1000)

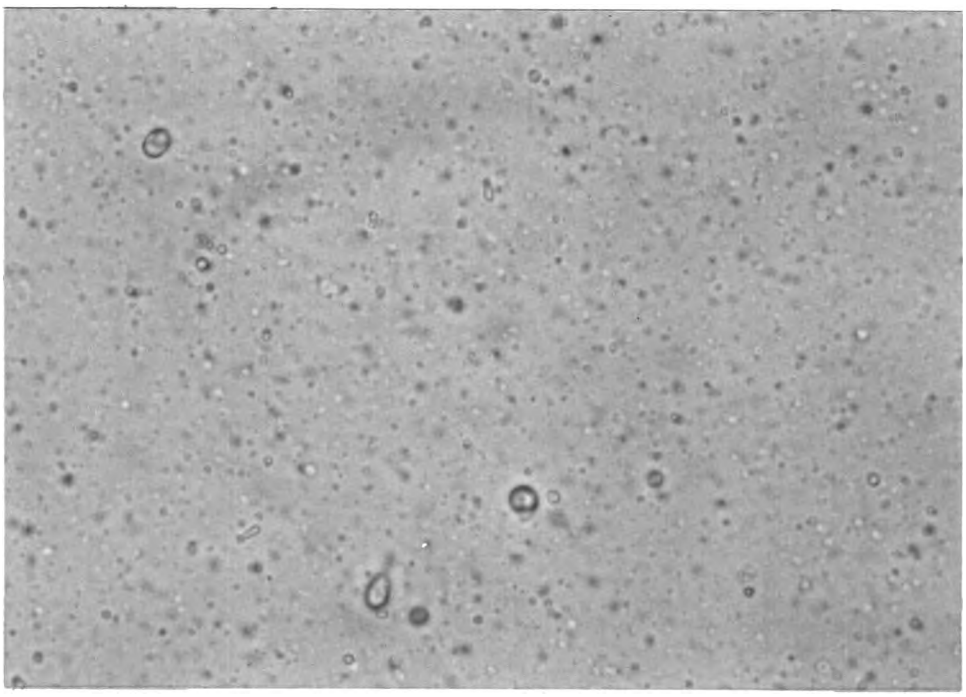


Figure E5 Photograph of niosomes prepared by Span® 40:CHO:Solulan® C-24 vesicles (x 1000)

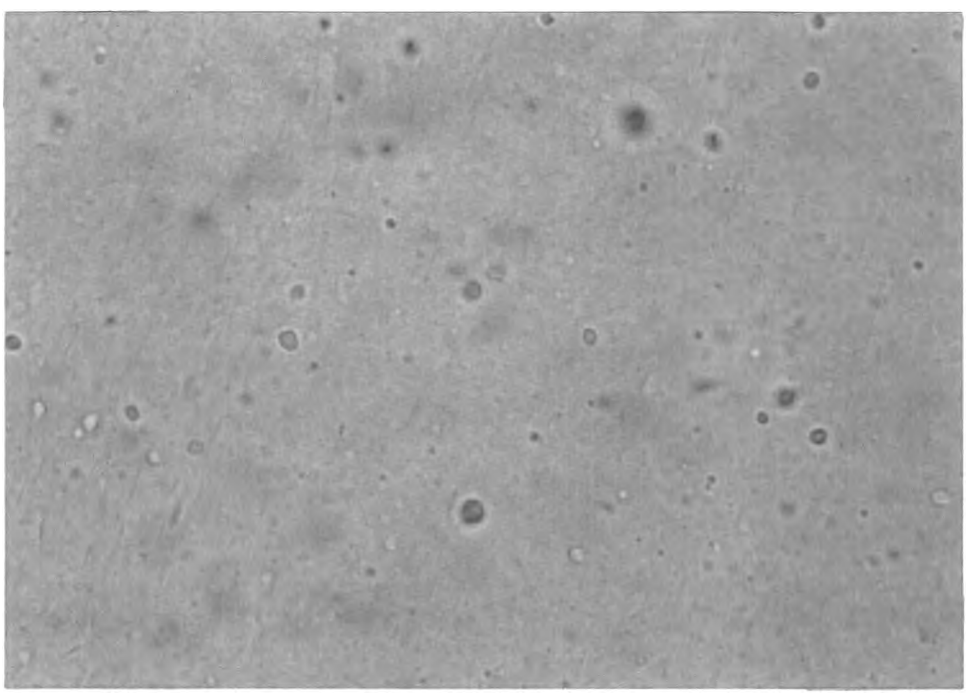


Figure E6 Photograph of niosomes prepared by GDS:CHO:Brij® 76 vesicles (x 1000)

APPENDIX F

DSC Thermogram of PTU Niosomes

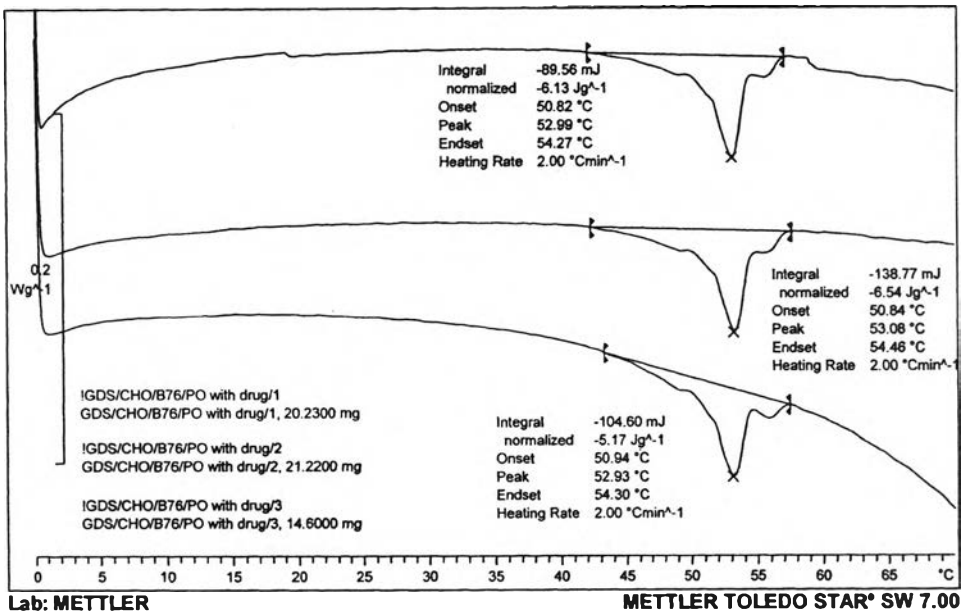


Figure F1 DSC thermogram of GDS:CHO:Brij® 76 niosomes

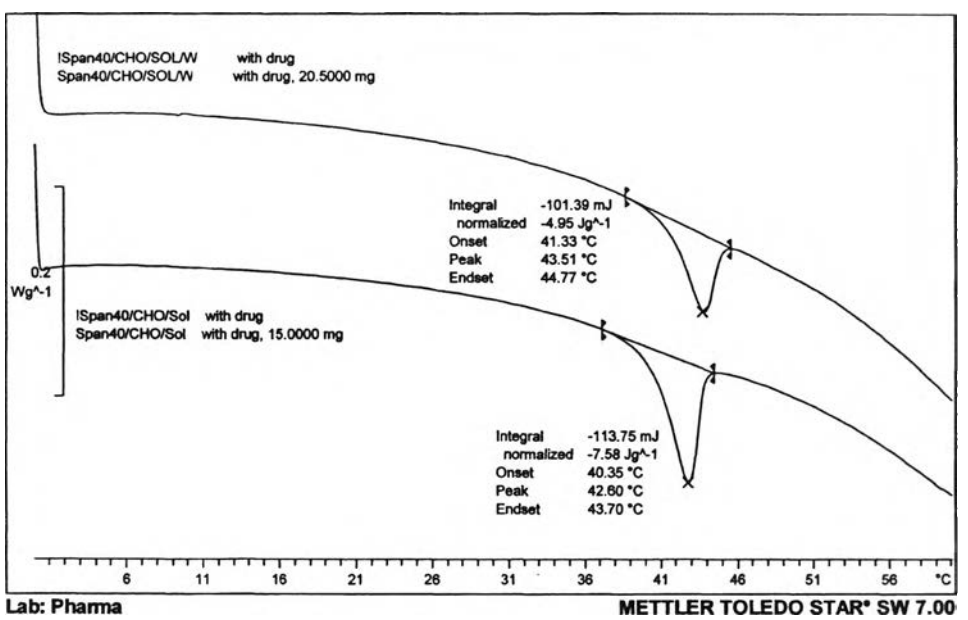


Figure F2 DSC thermogram of Span® 40:CHO:Solulan® C24 niosomes

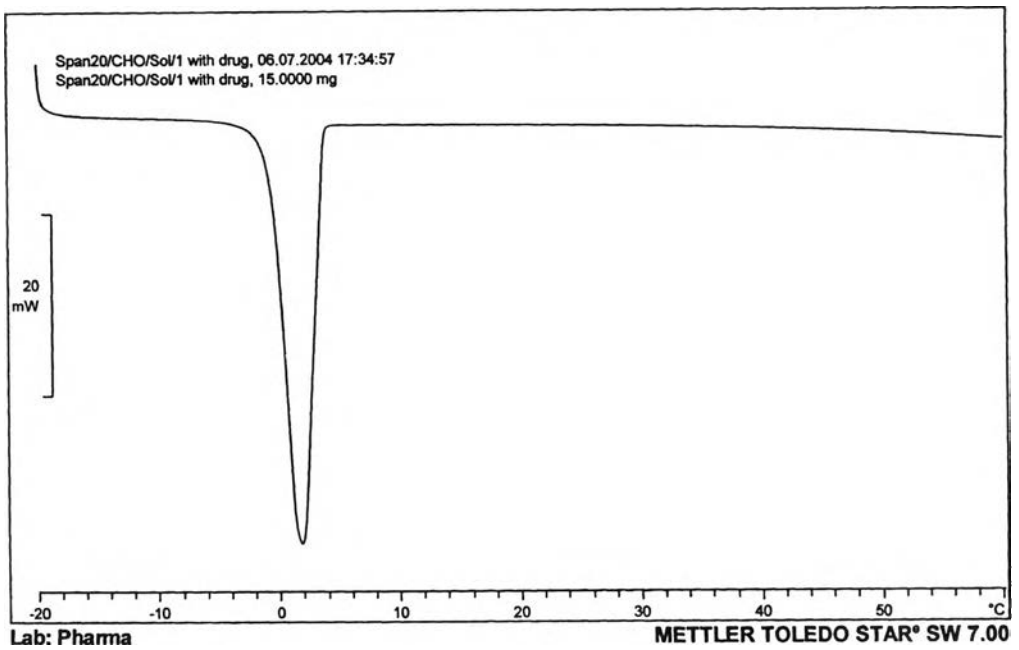


Figure F3 DSC thermogram of Span® 20:CHO:Solulan® C24 niosomes

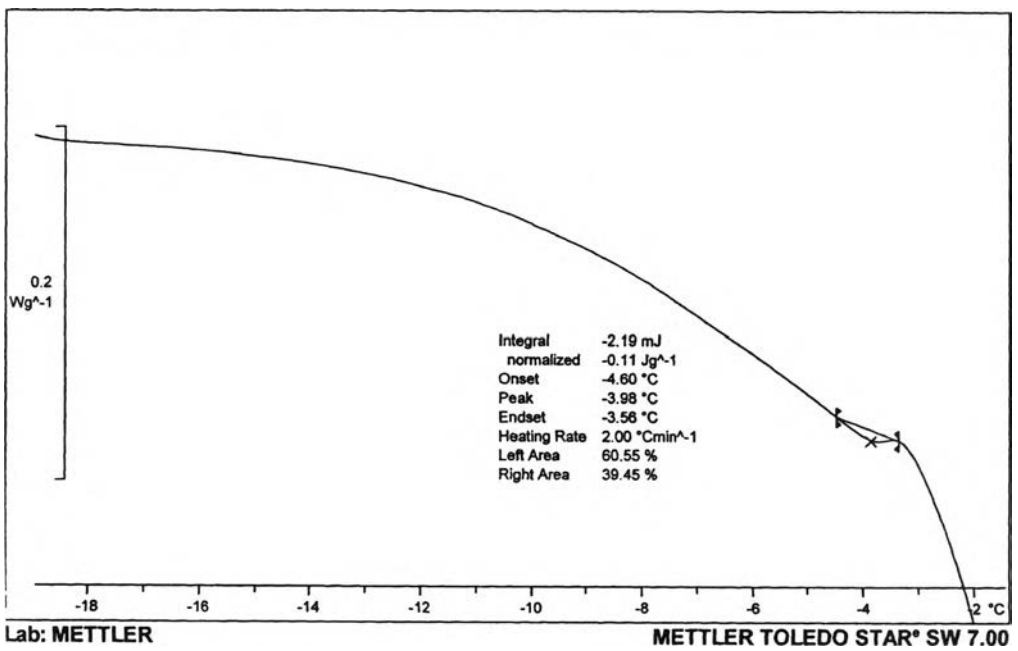


Figure F4 DSC thermogram of L-595:PEG-8-L niosomes

VITA

Ms Waraporn Suwakul was born on January 5, 1955 in Nakornpathom, Thailand. She received the Master of Sciences in Pharmacy from the Faculty of Pharmaceutical Sciences, Chulalongkorn University, Bangkok in 1983. Since graduation, she has worked as a faculty member at the Faculty of Pharmaceutical Sciences, Chulalongkorn University, Bangkok. She entered the doctorate program in Pharmaceutics at Chulalongkorn University in 2000.