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APPENDICES

APPENDIX I

MINOXIDIL

(Dennis, 1988)

Minoxidil

1. Description

1.1 Nomenclature

1.1.1 Chemical name

- 2, 4-Diamino-6-piperidinopyrimidine 3-oxide;
- 6-(1-piperidinyl)-2, 4-pyrimidinediamine 3-oxide;
- 6-piperidino-2, 4- diaminopyrimidine 3-oxide;
- 2, 3-dihydro-3-hydroxy-2-imino-6-(1-piperidinyl)-4-pyrimidinamine;
- 6-amino-1, 2-dihydro-1-hydroxy-2-imino-4-piperidinopyrimidine

1.1.2 Proprietary names

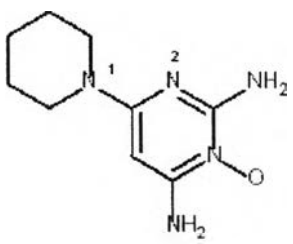
- Loniten, Prexidil, Rogain, Regain

1.2 Formulae

1.2.1 Empirical

- $C_9H_{15}N_5O$

1.2.2 Structural



1.3 Molecular weight

- 209.25

2. Adverse effect

Incidence less frequent is contact dermatitis (itching or skin rash). Allergic reaction and systemic reaction are rare.

APPENDIX II

PROPERTIES OF SOME SELECTED MATERIALS

Properties of some selected materials

Meterial	Formula	Property
Brij® 52 (Polyoxyethylene 2 cetyl ether)	$C_{20}H_{42}O_3$	MW : 330 MP : 33 °C HLB : 5.3
Brij® 76 (Polyoxyethylene 10 stearyl ether)	$C_{38}H_{78}O_{11}$	MW : 711 MP : 38 °C HLB : 12.4
Cholesterol	$C_{27}H_{46}O$	MW : 386.67 MP : 147-150 °C BP : 360 °C
Disodium hydrogen orthophosphate	Na_2HPO_4	MW : 141.96
Docusate sodium	$C_{20}H_{37}NaO\text{-}S$	MW : 444.56 MP : 153-157 °C
Gacial acetic acid	$C_2H_4O_2$	MW : 60.1
Glucose monohydrate	$C_6H_{12}O_6.H_2O$	MW : 198.17
Minoxidil	$C_9H_{15}N_5O$	MW : 209.3 MP : 225 °C pKa : 4.61 K : 1.24
Potassium dihydrogen orthophosphate	KH_2PO_4	MW : 136.09
Propylene glycol	$C_3H_8O_2$	MW : 76.09 BP : 188 °C
Prednisolone	$C_{21}H_{28}O_5$	MW : 360.4 MP : 235 °C
Sodium chloride	NaCl	MW : 58.44

Meterial	Formula	Property
Sodium dodecyl sulfate	$C_{12}H_{25}NaO_4S$	MW : 288.38 MP : 204-207 °C HLB : 40
Solulan® C24 (Polyethoxylated -24 mole-cholesterol)	-	MW : 1,443 HLB : 8-9 Cloud point : 88-95 °C
Span® 40 (Sorbitan monopalmitate)	$C_{22}H_{42}O_6$	MP : 44-51 °C HLB : 6.7
Span® 60 (Sorbitan monosterate)	$C_{24}H_{46}O_6$	MP : 50-55 °C HLB : 4.7

APPENDIX III

VALIDATION OF UV METHOD

Analytical parameters validated were linearity, accuracy, precision, and specificity. The validation of an analytical method was the process by which performance characteristics of the method were established to meet the USP 27 (The United States Pharmacopieal Convention, 2004) requirements for the intended analytical application.

1. Linearity

Figure 1 showed the calibration curve of minoxidil solution in water in the concentration range studied (4, 6, 8, 10, 12, and 14 µg/ml, respectively). The calibration curve data is shown in Table 1. Linear regression analysis of the absorbances versus the corresponding concentrations was performed, and the coefficient of determination was calculated as > 0.999. The calibration data were found to be linear with excellent coefficient of determination. These results indicated that UV spectrophotometric method was acceptable for quantitative analysis of minoxidil in this study.

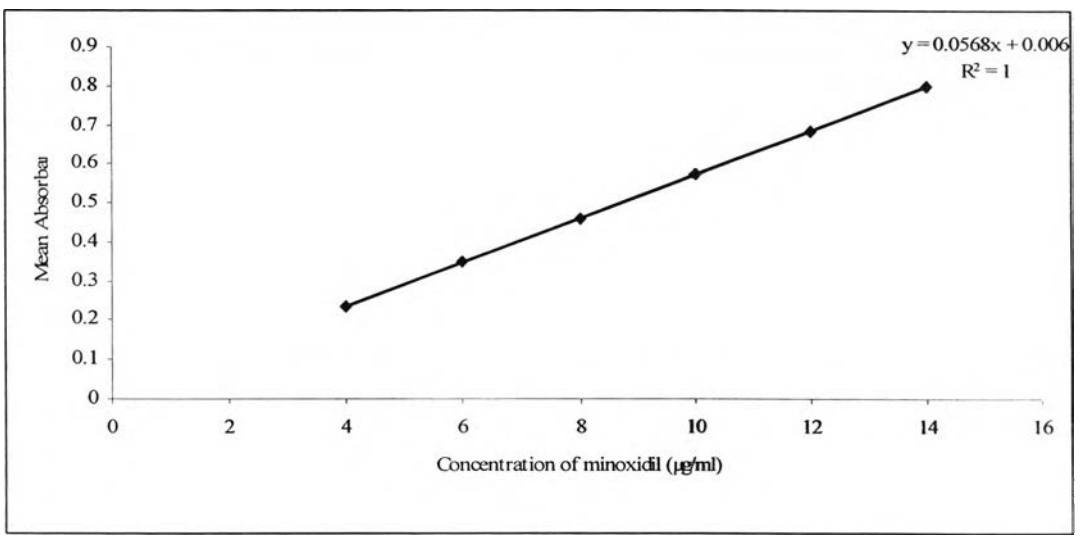


Figure 1. A representation of calibration curve of minoxidil analysis by UV spectrophotometric method

Table1. Data of calibration curve of minoxidil analysis by UV spectrophotometric method

Concentration (μg/ml)	Absorbance			Mean ± SD	%CV
	Set 1	Set 2	Set 3		
4	0.233	0.230	0.239	0.233 ± 0.003	1.082
6	0.348	0.345	0.348	0.347 ± 0.002	0.499
8	0.462	0.457	0.460	0.460 ± 0.003	0.547
10	0.574	0.572	0.579	0.575 ± 0.004	0.627
12	0.686	0.688	0.683	0.686 ± 0.003	0.367
14	0.806	0.798	0.799	0.801 ± 0.004	0.544
R^2	0.9999	1	0.9998	-	-

2. Accuracy

The accuracy of an analytical method is the closeness of test results obtained to the true value. Minoxidil in surfactant/cholesterol mixtures at 5, 9, and 13 μg/ml of minoxidil and 100 mg/ml of lipid mixture were prepared. Five sets of each concentration were prepared. Each individual sample was analyzed by UV spectrophotometry, and percent analytical recovery of each sample is shown in Table 2 and Table 3, respectively. All percentages of analytical recovery were in the range of 99.68-100.62%, which indicate the high accuracy of this study. The mean of the percentage of analytical recovery should generally be 98-102%.

Table 2. The estimated concentrations of minoxidil by UV spectrophotometric method

Concentration (μg/ml)	Estimated concentration (μg/ml)					Mean ± SD
	Set 1	Set 2	Set 3	Set 4	Set 5	
5	4.9536	4.9823	5.0335	4.9997	4.9510	4.9840 ± 0.03
9	8.9650	9.0788	9.0336	8.9745	9.0006	9.0105 ± 0.05
13	13.117	13.079	13.057	13.007	13.146	13.0812 ± 0.05

Table 3. The percentages of analytical recovery of minoxidil by UV spectrophotometric method

Concentration (µg/ml)	Analytical recovery					Mean ± SD
	Set 1	Set 2	Set 3	Set 4	Set 5	
5	99.07	99.65	100.67	99.99	99.02	99.68 ± 0.69
9	99.61	100.88	100.37	99.72	100.01	100.12 ± 0.52
13	100.90	100.61	100.44	100.05	101.12	100.62 ± 0.41

3. Precision

3.1 Within run precision

The within run precision was determined by analyzing of five sets of the calibration curve in the same day. Inverse concentrations of three other concentrations (5, 9, and 13 µg/ml) of minoxidil were compared, and the percent coefficient of variation (% CV) for each concentration was calculated and is shown in Table 4.

3.2 Between run precision

The between run precision was determined in a similar manner to the within run precision but on five different days. The percent coefficient of variation (% CV) for each concentration was calculated and is shown in Table 5.

The percent coefficient of variation (% CV) of analytical method should generally be < 2%. All the values were less than 2%, the UV spectrophotometric method was acceptable for quantitative analysis of minoxidil in this study.

Table 4. Data of within run precision of minoxidil by UV spectrophotometric method

Nominal concentration (μg/ml)	Calculated concentration					Mean ± SD	%CV
	Set 1	Set 2	Set 3	Set 4	Set 5		
5	4.992	5.076	5.003	4.961	5.057	5.018 ± 0.048	0.95
9	8.990	9.114	8.936	9.051	9.166	9.051 ± 0.092	1.02
13	12.938	13.054	13.248	12.979	13.170	13.078 ± 0.130	0.99

Table 5. Data of between run precision of minoxidil by UV spectrophotometric method

Nominal concentration (μg/ml)	Calculated concentration					Mean ± SD	%CV
	Set 1	Set 2	Set 3	Set 4	Set 5		
5	5.003	5.018	5.006	4.956	4.877	4.972 ± 0.058	1.17
9	8.990	9.012	8.989	8.989	9.106	9.015 ± 0.052	0.58
13	13.054	12.909	12.984	13.262	13.015	13.045 ± 0.133	1.02

4. Specificity

Specificity expresses how much the results obtained by the method for a given analyst are influenced by the presence of foreign substances. The UV spectra of noisome formulas without drug are shown in Figures 2-5. No interference peaks are seen at 288 nm.

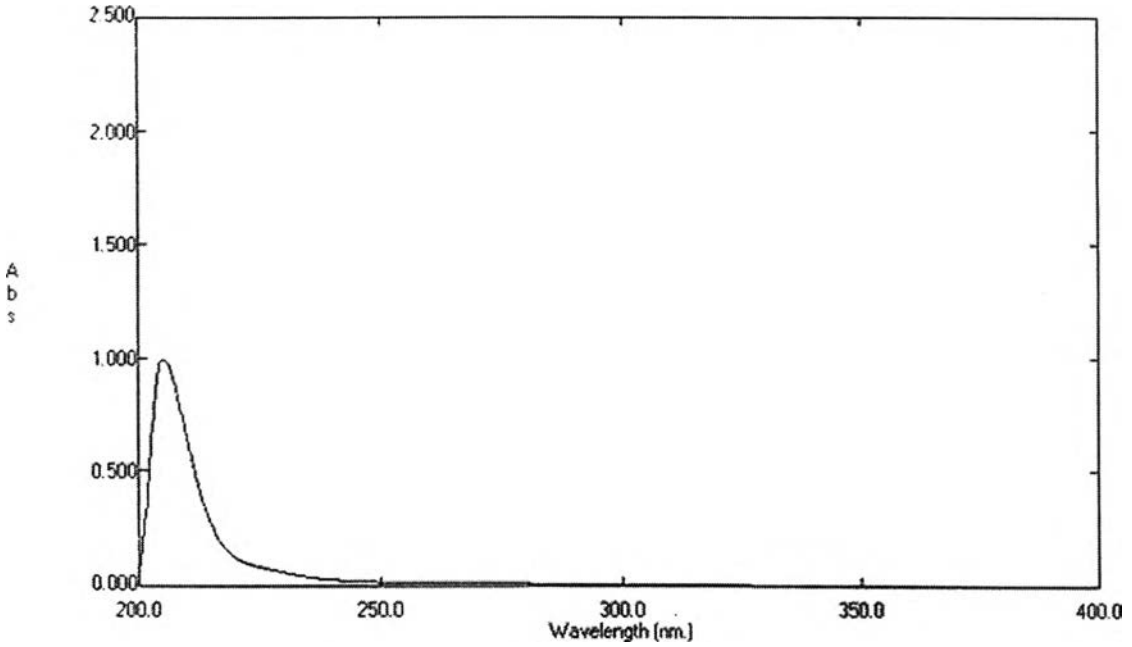


Figure 2. UV spectrum of Span® 40:CHO:Solulan® C24 niosomes (without drug) dissolved in isopropanol

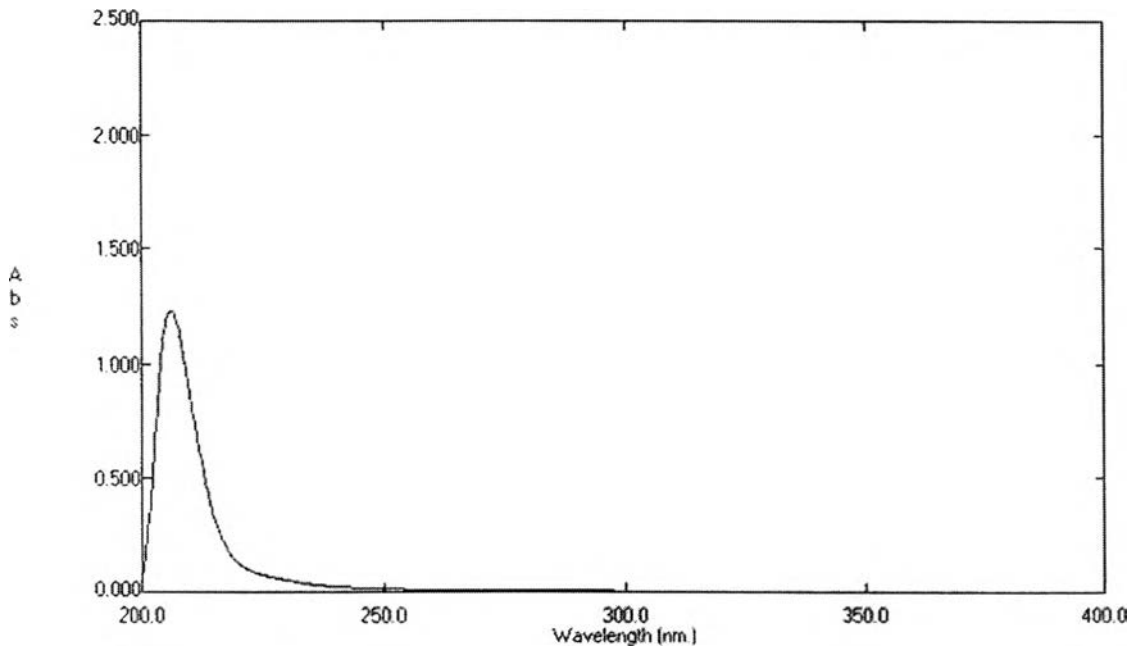


Figure 3. UV spectrum of Span® 60:CHO:Solulan® C24 niosomes (without drug) dissolved in isopropanol

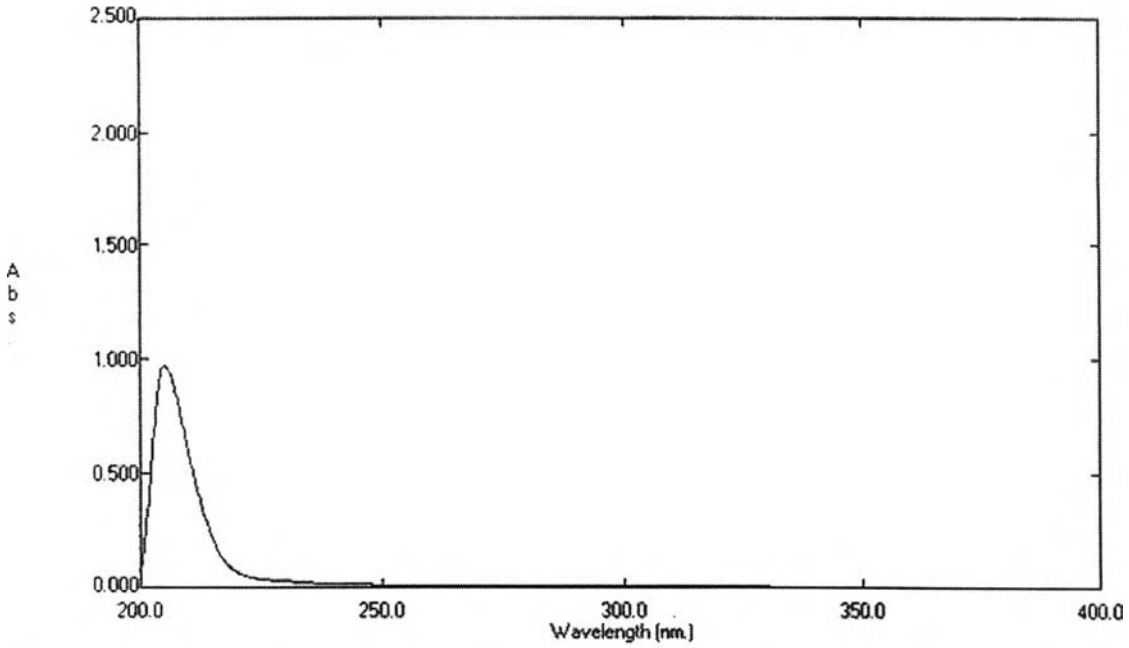


Figure 4. UV spectrum of Brij® 52:CHO:Solulan® C24 niosomes (without drug) dissolved in isopropanol

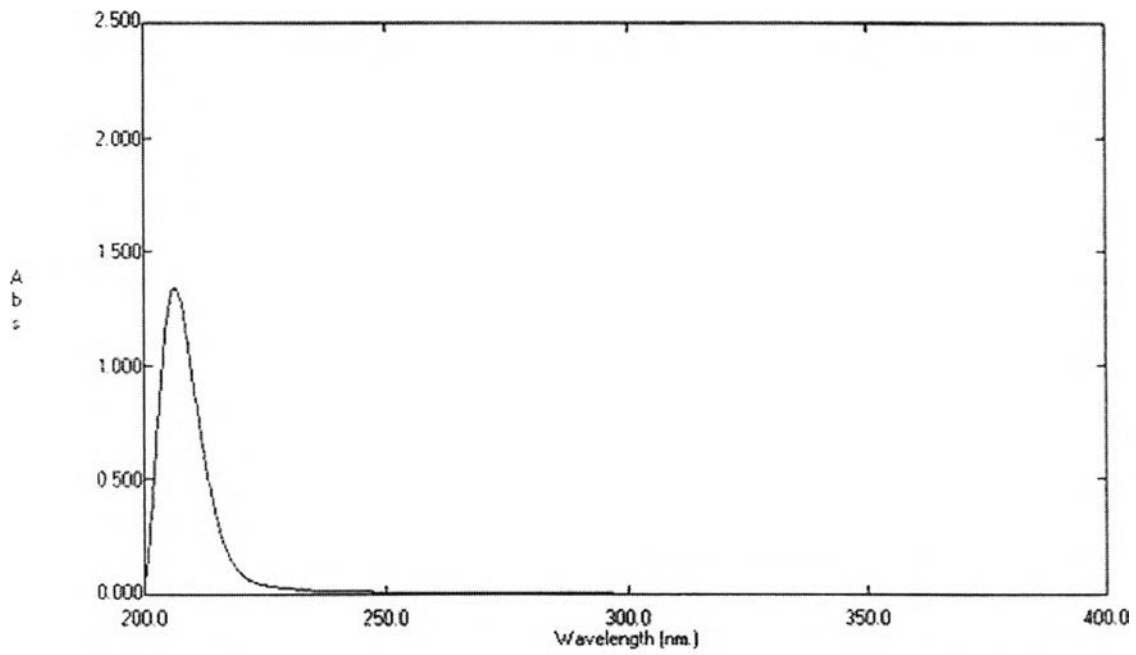


Figure 5. UV spectrum of Brij® 76:CHO:Solulan® C24 niosomes (without drug) dissolved in isopropanol

APPENDIX IV

VALIDATION OF HPLC METHOD

The HPLC system was applied to analyzed minoxidil. Linearity, accuracy, precision, and specificity were the analytical parameters for validation of the HPLC method. The validation of analytical method is the process for evaluation that the method is suitable and reliable for the intended analytical applications.

1. 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 analyze in samples within a given range. The linearity is usually expressed in terms 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 calibration curve data of minoxidil solution are shown in Table 1. The plot of minoxidil concentrations versus the peak area ratios of minoxidil and its internal standard (Figure 1) illustrates the linear correlation in the concentration range studied (0.2-20 μg/ml). The coefficient of determination (R^2) of this line was 0.9999. These results indicated that HPLC method was acceptable for quantitative analysis of minoxidil in the range studied.

Table 1. Data of calibration curve of minoxidil by HPLC method

Concentration (μg/ml)	Peak area ratio			Mean ± SD	% CV
	Set 1	Set 2	Set 3		
0.2	0.0194	0.0199	0.0193	0.0195 ± 0.0003	1.69
4	0.4074	0.4011	0.4105	0.4063 ± 0.0048	1.18
8	0.7941	0.7973	0.7999	0.7971 ± 0.0029	0.36
12	1.2244	1.2180	1.2062	1.2162 ± 0.0093	0.76
16	1.6274	1.6262	1.6237	1.6258 ± 0.0019	0.12
20	2.0263	2.0101	2.0400	2.0255 ± 0.0150	0.74
R^2	0.9999	0.9999	0.9999	-	-

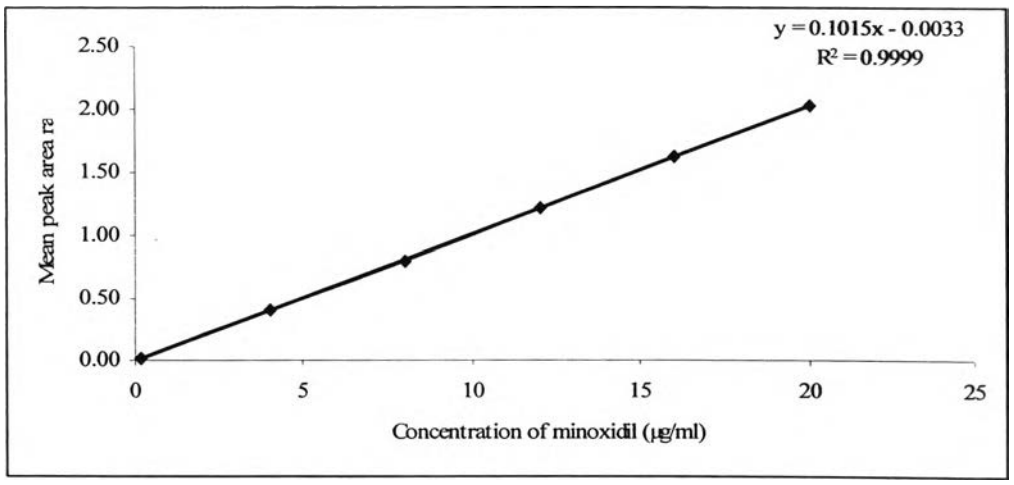


Figure 1. Calibration curve of minoxidil by HPLC method

2. Accuracy

The accuracy of an analytical method is the closeness of test results obtained to the true value. Minoxidil in surfactant/cholesterol mixtures at 0.4, 10, and 18 µg/ml of minoxidil and 100 mg/ml of lipid mixture were prepared. Five sets of each concentration were prepared. The inversely estimated concentration is shown in Table 2, and Table 3 shows the percentages of analytical recovery of minoxidil concentration. The study with accuracy indicated that this method could be used for analysis of minoxidil in all concentrations.

Table 2. The inversely estimated concentrations of minoxidil by HPLC method

Concentration (µg/ml)	Estimated concentration (µg/ml)					Mean ± SD
	Set 1	Set 2	Set 3	Set 4	Set 5	
0.4	0.3998	0.4071	0.4003	0.4042	0.3990	0.4021 ± 0.00
10	9.9203	9.9437	9.9698	9.9722	9.8636	9.9339 ± 0.04
18	18.2551	17.6987	18.0793	18.0649	18.3799	18.0956± 1.13

Table 3. The percentage of analytical recovery of minoxidil by HPLC method

Concentration (μg/ml)	Analytical recovery					Mean ± SD
	Set 1	Set 2	Set 3	Set 4	Set 5	
0.4	99.9465	101.7860	100.0736	101.0448	99.7493	100.5200±0.87
10	99.2032	99.4372	99.6975	99.7216	98.6362	100.1511±1.13
18	101.4174	98.3259	100.4403	100.3606	100.2111	99.3392 ± 0.45

3. Precision

The precision of an analytical method is the degree of agreement among individual test results when the method 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) of a series of measurement. The determination of precision of the analysis of minoxidil was performed by analyzing the coefficient of variation of five sets of three standard solutions (0.4, 10, 18 μg/ml).

Table 4 and Table 5 illustrate the data of within run precision and between run precision, respectively. All coefficient of variation values were 0.74-1.12% and 0.97-1.77%. The coefficient of variation of an analytical method should generally be less than 2%. Since all the values were less than 2%, the HPLC method could be used for quantitative analysis of minoxidil in the range studied.

Table 4. Data of within run precision by HPLC method

Nominal concentration (μg/ml)	Calculated concentration					Mean ± SD	% CV
	Set 1	Set 2	Set 3	Set 4	Set 5		
0.4	0.4232	0.4196	0.4175	0.4152	0.4108	0.4173 ± 0.0047	1.12
10	10.0247	10.0900	10.1216	10.0200	10.2001	10.0913±0.0746	0.74
18	17.7464	17.9592	18.0100	17.8166	18.2471	17.9559±0.1943	1.08

Table 5. Data of between run precision by HPLC method

Nominal concentration (μg/ml)	Calculated concentration					Mean ± SD	% CV
	Set 1	Set 2	Set 3	Set 4	Set 5		
0.4	0.4051	0.3918	0.4027	0.4103	0.3977	0.4015 ± 0.0071	1.77
10	9.9903	10.0020	10.0746	10.1394	9.9294	10.0271±0.0812	0.81
18	17.8166	18.1556	18.1283	18.1925	18.2748	18.1136±0.1749	0.97

4. Specificity

The specificity is the ability to assess unequivocally the analyze in the presence of other component in the sample. The peak of minoxidil and prednisolone (internal standard) must be completely separated and not be interfered by the peaks of other components in the sample under the HPLC condition used. The peaks of minoxidil and prednisoline had appropriate resolution and were clearly separated from peaks of other components. The chromatograms are shown in Figures 2-5. The retention times of minoxidil and prednisolone were at about 17 and 3 min, respectively.

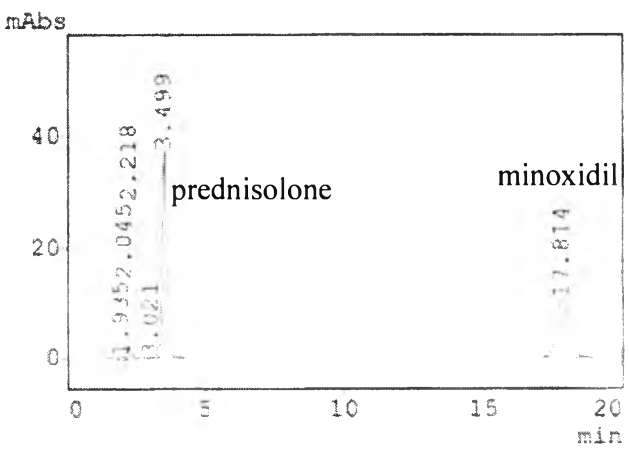


Figure 2. HPLC chromatogram of minoxidil and prednisolone base in Span®40:CHO:Solulan® C24 niosomes

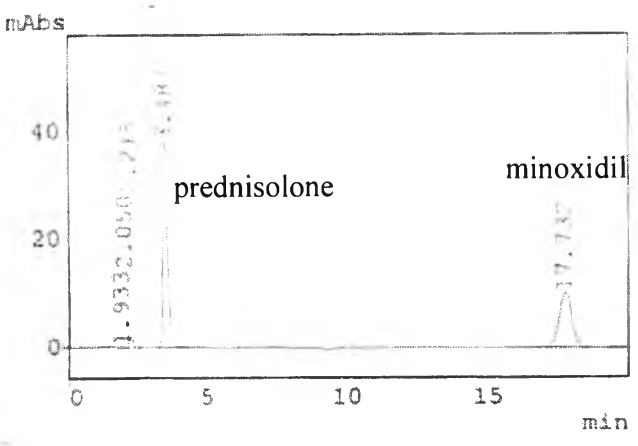


Figure 3. HPLC chromatogram of minoxidil and prednisolone base in Span® 60:CHO:Solulan® C24 niosomes

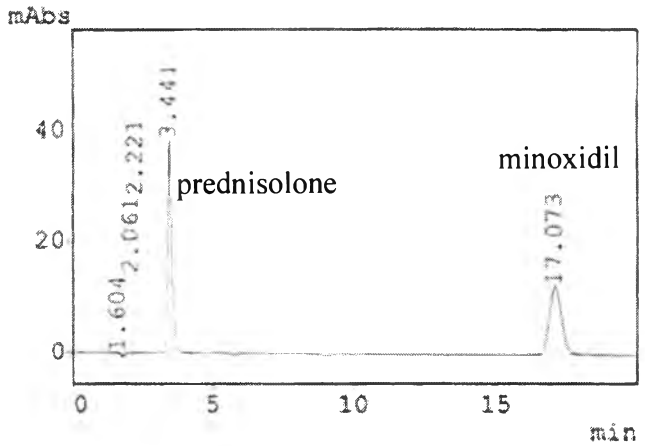


Figure 4. HPLC chromatogram of minoxidil and prednisolone base in Brij® 52:CHO:Solulan® C24 niosomes

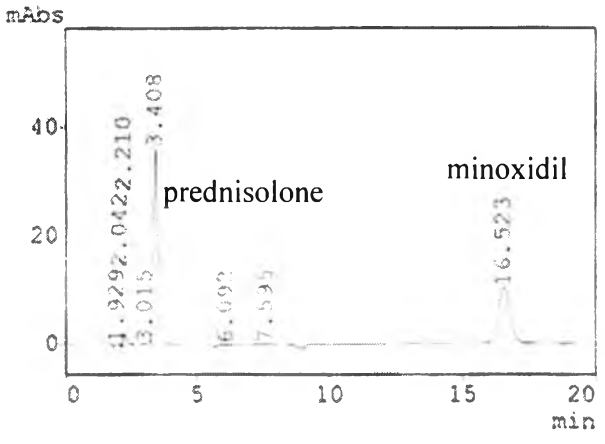


Figure 5. HPLC chromatogram of minoxidil and prednisolone base in brij® 76:CHO:Solulan® C24 niosomes

APPENDIX VII

STATISTICAL ANALYSIS

Table 1. One-way analysis of variance of entrapment efficiency

ANOVA

EE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	73.610	3	24.537	480.149	.000
Within Groups	.409	8	5.110E-02		
Total	74.019	11			

Table 2. Multiple comparisons of variance of entrapment efficiency

Multiple Comparisons

Dependent Variable: EE

Tukey HSD

(I) NIOSOME	(J) NIOSOME	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	2.00	-1.8441*	.1846	.000	-2.4352	-1.2530
	3.00	4.8126*	.1846	.000	4.2215	5.4037
	4.00	2.0922*	.1846	.000	1.5011	2.6833
2.00	1.00	1.8441*	.1846	.000	1.2530	2.4352
	3.00	6.6567*	.1846	.000	6.0656	7.2478
	4.00	3.9363*	.1846	.000	3.3452	4.5274
3.00	1.00	-4.8126*	.1846	.000	-5.4037	-4.2215
	2.00	-6.6567*	.1846	.000	-7.2478	-6.0656
	4.00	-2.7204*	.1846	.000	-3.3115	-2.1293
4.00	1.00	-2.0922*	.1846	.000	-2.6833	-1.5011
	2.00	-3.9363*	.1846	.000	-4.5274	-3.3452
	3.00	2.7204*	.1846	.000	2.1293	3.3115

*. The mean difference is significant at the .05 level.

Table 3. One-way analysis of variance of Span® 40 niosomes in physical stability study

ANOVA

SPAN40

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.583E-02	3	1.528E-02	.095	.961
Within Groups	1.284	8	.161		
Total	1.330	11			

Table 4. One-way analysis of variance of Span® 60 niosomes in physical stability study

ANOVA

SPAN60

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.034E-03	3	2.678E-03	.035	.991
Within Groups	.610	8	7.629E-02		
Total	.618	11			

Table 5. One-way analysis of variance of Brij® 52 niosomes in physical stability study

ANOVA

BRIJ52

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.232E-02	3	7.440E-03	.124	.943
Within Groups	.479	8	5.990E-02		
Total	.502	11			

Table 6. One-way analysis of variance of Brij® 76 niosomes in physical stability study

ANOVA

BRIJ76

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.436E-02	3	1.479E-02	.081	.968
Within Groups	1.453	8	.182		
Total	1.498	11			

Table 7. One-way analysis of variance of MN in solution in chemical stability study

ANOVA

SOL

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	43.791	9	4.866	1.639	.171
Within Groups	59.363	20	2.968		
Total	103.154	29			

Table 8. One-way analysis of variance of MN in Span® 40 niosomes in chemical stability study

ANOVA

S40

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.563	9	1.285	.553	.819
Within Groups	46.500	20	2.325		
Total	58.063	29			

Table 9. One-way analysis of variance of MN in Span® 60 niosomes in chemical stability study

ANOVA

S60

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.706	9	.412	1.007	.467
Within Groups	8.183	20	.409		
Total	11.890	29			

Table 10. One-way analysis of variance of MN in Brij® 52 niosomes in chemical stability study

ANOVA

B52

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.129	9	.459	.478	.872
Within Groups	19.186	20	.959		
Total	23.316	29			

Table 11. One-way analysis of variance of MN in Brij® 76 niosomes in chemical stability study

ANOVA

B76

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	22.969	9	2.552	2.103	.080
Within Groups	24.267	20	1.213		
Total	47.237	29			

Table 12. One-way analysis of variance of MN in Span® 40, Span® 60, Brij® 52, and Brij® 76 niosomal suspensions exposed to UV light for 90 days

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
S40LIGHT	Between Groups	1397666	9	155296.2	366.739	.000
	Within Groups	8469.039	20	423.452		
	Total	1406135	29			
S60LIGHT	Between Groups	470021.2	9	52224.580	170.982	.000
	Within Groups	6108.783	20	305.439		
	Total	476130.0	29			
B52LIGHT	Between Groups	3208956	9	356550.7	349.199	.000
	Within Groups	20421.050	20	1021.053		
	Total	3229377	29			
B76LIGHT	Between Groups	1546787	9	171865.2	143.874	.000
	Within Groups	23891.140	20	1194.557		
	Total	1570678	29			

Table 13. Multiple comparisons of variance of MN in Span®40, Span®60, Brij® 52, and Brij® 76 niosomal suspensions exposed to UV light for 90 days

Multiple Comparisons

Dunnett t (2-sided) [a]

Dependent Variable	(I) TIME	(J) TIME	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
S40LIGHT	10.00	.00	-199.9976*	16.8018	.000	-249.5008	-150.4943
	20.00	.00	-274.5647*	16.8018	.000	-324.0679	-225.0614
	30.00	.00	-374.8032*	16.8018	.000	-424.3065	-325.3000
	40.00	.00	-498.8664*	16.8018	.000	-548.3696	-449.3631
	50.00	.00	-534.9621*	16.8018	.000	-584.4653	-485.4588
	60.00	.00	-613.4223*	16.8018	.000	-662.9255	-563.9191
	70.00	.00	-653.3665*	16.8018	.000	-702.8697	-603.8632
	80.00	.00	-666.7709*	16.8018	.000	-716.2742	-617.2677
	90.00	.00	-649.7664*	16.8018	.000	-699.2696	-600.2631
S60LIGHT	10.00	.00	-70.8524*	14.2698	.001	-112.8954	-28.8094
	20.00	.00	-187.0333*	14.2698	.000	-229.0763	-144.9902
	30.00	.00	-252.2904*	14.2698	.000	-294.3334	-210.2473
	40.00	.00	-262.8174*	14.2698	.000	-304.8605	-220.7744
	50.00	.00	-355.2988*	14.2698	.000	-397.3418	-313.2558
	60.00	.00	-337.3510*	14.2698	.000	-379.3940	-295.3080
	70.00	.00	-362.8793*	14.2698	.000	-404.9223	-320.8363
	80.00	.00	-391.4585*	14.2698	.000	-433.5015	-349.4154
	90.00	.00	-332.1397*	14.2698	.000	-374.1827	-290.0966
B52LIGHT	10.00	.00	-186.9498*	26.0903	.000	-263.8196	-110.0801
	20.00	.00	-271.8207*	26.0903	.000	-348.6905	-194.9510
	30.00	.00	-476.6519*	26.0903	.000	-553.5216	-399.7821
	40.00	.00	-559.2124*	26.0903	.000	-636.0822	-482.3426
	50.00	.00	-691.5338*	26.0903	.000	-768.4036	-614.6641
	60.00	.00	-805.2060*	26.0903	.000	-882.0758	-728.3363
	70.00	.00	-895.9736*	26.0903	.000	-972.8433	-819.1038
	80.00	.00	-958.3577*	26.0903	.000	-1035.23	-881.4880
	90.00	.00	-988.2154*	26.0903	.000	-1065.09	-911.3456
B76LIGHT	10.00	.00	-184.9175*	28.2201	.000	-268.0622	-101.7727
	20.00	.00	-222.5499*	28.2201	.000	-305.6946	-139.4051
	30.00	.00	-318.2849*	28.2201	.000	-401.4297	-235.1402
	40.00	.00	-426.8252*	28.2201	.000	-509.9700	-343.6804
	50.00	.00	-515.0033*	28.2201	.000	-598.1480	-431.8585
	60.00	.00	-575.8324*	28.2201	.000	-658.9772	-492.6876
	70.00	.00	-641.3946*	28.2201	.000	-724.5394	-558.2498
	80.00	.00	-684.8755*	28.2201	.000	-768.0203	-601.7308
	90.00	.00	-707.5146*	28.2201	.000	-790.6593	-624.3698

*. The mean difference is significant at the .05 level.

a. Dunnett t-tests treat one group as a control, and compare all other groups against it.

Table 14. Multiple comparisons of variance of MN in Span®40, Span®60, Brij® 52, and Brij® 76 niosomal pellets exposed to UV light for 90 days

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
S40LIGHT	Between Groups	2196.630	9	244.070	17.181	.000
	Within Groups	284.123	20	14.206		
	Total	2480.754	29			
S60LIGHT	Between Groups	7224.228	9	802.692	13.377	.000
	Within Groups	1200.134	20	60.007		
	Total	8424.362	29			
B52LIGHT	Between Groups	4373.459	9	485.940	35.412	.000
	Within Groups	274.448	20	13.722		
	Total	4647.907	29			
B76LIGHT	Between Groups	60790.396	9	6754.488	33.048	.000
	Within Groups	4087.645	20	204.382		
	Total	64878.041	29			

Table 15. Multiple comparisons of variance of MN in Span®40, Span®60, Brij® 52, and Brij® 76 niosomal pellets exposed to UV light for 90 days

Multiple Comparisons

Dunnett t (2-sided) [a]

Dependent Variable	(I) TIME	(J) TIME	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
S40LIGHT	10.00	.00	7.5144	3.0775	.135	-1.5527	16.5815
	20.00	.00	-2.4819	3.0775	.966	-11.5490	6.5852
	30.00	.00	2.8829	3.0775	.926	-6.1842	11.9500
	40.00	.00	-4.0822	3.0775	.707	-13.1494	4.9849
	50.00	.00	-7.0004	3.0775	.183	-16.0676	2.0667
	60.00	.00	-13.3877*	3.0775	.002	-22.4548	-4.3206
	70.00	.00	-16.0370*	3.0775	.000	-25.1041	-6.9698
	80.00	.00	-16.9781*	3.0775	.000	-26.0452	-7.9109
	90.00	.00	-18.1548*	3.0775	.000	-27.2220	-9.0877
S60LIGHT	10.00	.00	-12.0600	6.3249	.337	-30.6951	6.5751
	20.00	.00	-5.7658	6.3249	.935	-24.4009	12.8693
	30.00	.00	2.4874	6.3249	1.000	-16.1477	21.1225
	40.00	.00	12.3531	6.3249	.314	-6.2820	30.9882
	50.00	.00	-16.3494	6.3249	.103	-34.9845	2.2857
	60.00	.00	13.3739	6.3249	.241	-5.2612	32.0090
	70.00	.00	-25.4851*	6.3249	.005	-44.1202	-6.8500
	80.00	.00	-27.3035*	6.3249	.002	-45.9386	-8.6684
	90.00	.00	-32.6250*	6.3249	.000	-51.2601	-13.9899
B52LIGHT	10.00	.00	2.6224	3.0246	.950	-6.2890	11.5338
	20.00	.00	-9.7781*	3.0246	.027	-18.6895	-.8667
	30.00	.00	-14.6341*	3.0246	.001	-23.5455	-5.7227
	40.00	.00	-12.9910*	3.0246	.003	-21.9024	-4.0796
	50.00	.00	-26.4678*	3.0246	.000	-35.3792	-17.5564
	60.00	.00	-28.2333*	3.0246	.000	-37.1447	-19.3219
	70.00	.00	-24.2051*	3.0246	.000	-33.1165	-15.2937
	80.00	.00	-33.5534*	3.0246	.000	-42.4648	-24.6420
	90.00	.00	-30.1798*	3.0246	.000	-39.0912	-21.2684
B76LIGHT	10.00	.00	-4.9662	11.6728	1.000	-39.3579	29.4254
	20.00	.00	-8.0769	11.6728	.986	-42.4685	26.3148
	30.00	.00	-32.2128	11.6728	.073	-66.6045	2.1788
	40.00	.00	-67.2634*	11.6728	.000	-101.6551	-32.8717
	50.00	.00	-82.3249*	11.6728	.000	-116.7166	-47.9333
	60.00	.00	-70.9426*	11.6728	.000	-105.3342	-36.5509
	70.00	.00	-99.3252*	11.6728	.000	-133.7169	-64.9335
	80.00	.00	-127.7199*	11.6728	.000	-162.1115	-93.3282
	90.00	.00	-118.0965*	11.6728	.000	-152.4882	-83.7048

*. The mean difference is significant at the .05 level.

a. Dunnett t-tests treat one group as a control, and compare all other groups against it.

Table 16. One-way analysis of variance of MN in Span® 40, Span® 60, Brij® 52, and Brij® 76 niosomal supernatants exposed to UV light for 90 days

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
S40LIGHT	Between Groups	1307239	9	145248.8	403.187	.000
	Within Groups	7205.034	20	360.252		
	Total	1314444	29			
S60LIGHT	Between Groups	436395.2	9	48488.355	283.394	.000
	Within Groups	3421.978	20	171.099		
	Total	439817.2	29			
B52LIGHT	Between Groups	2987690	9	331965.6	293.959	.000
	Within Groups	22585.854	20	1129.293		
	Total	3010276	29			
B76LIGHT	Between Groups	1017449	9	113049.9	123.077	.000
	Within Groups	18370.619	20	918.531		
	Total	1035819	29			

	60.00	.00	-350.7249*	10.6802	.000	-382.1919	-319.2579
	70.00	.00	-337.3941*	10.6802	.000	-368.8611	-305.9271
	80.00	.00	-364.1549*	10.6802	.000	-395.6219	-332.6879
	90.00	.00	-299.5146*	10.6802	.000	-330.9816	-268.0476
B52LIGHT	10.00	.00	-189.5723*	27.4383	.000	-270.4138	-108.7307
	20.00	.00	-262.0426*	27.4383	.000	-342.8841	-181.2010
	30.00	.00	-462.0178*	27.4383	.000	-542.8594	-381.1762
	40.00	.00	-546.2215*	27.4383	.000	-627.0630	-465.3799
	50.00	.00	-665.0661*	27.4383	.000	-745.9077	-584.2245
	60.00	.00	-776.9728*	27.4383	.000	-857.8143	-696.1312
	70.00	.00	-871.7685*	27.4383	.000	-952.6101	-790.9269
	80.00	.00	-924.8043*	27.4383	.000	-1005.65	-843.9623
	90.00	.00	-958.0356*	27.4383	.000	-1038.88	-877.1941
B76LIGHT	10.00	.00	-179.9513*	24.7458	.000	-252.8598	-107.0427
	20.00	.00	-214.4730*	24.7458	.000	-287.3816	-141.5645

ต้นฉบับ หน้าขาดหาย

VITA

Miss Monchida Kanjanapadit was born on October 20, 1978 in Lopburi, Thailand. She received her Bachelor of Science in Pharmacy in 2000 from the Faculty of Pharmaceutical Science, Srinakharinwirot University, Thailand. Before she entered the master's degree program in Pharmacy at Chulalongkorn University in 2003, she had worked at Bangpahun Hospital, Ayuthaya.