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APPENDIX A

Liquid Crystal Formation from Different Surfactants and Lecithin at Different Ratios, as Observed under a Polarized Light Microscope at 7 Days and 2 Months

Table A.1. Liquid Crystal Formation from Brij®72 (B72), Arlamol®E (A) and Water (W)

Component (%w/w)			Liquid crystal formation	
B72	**A**	**W**	**At 7 days**	**At 2 months**
5	10	85	@partly found	@partly found
	20	75	@partly found	not found
	30	65	not found	not found
	40	55	not found	not found
	50	45	not found, 2 separated phases	not found, 2 separated phases
	60	35	not found, 2 separated phases	not found, 2 separated phases
10	10	80	&found	&found
	20	70	@partly found	@partly found
	30	60	@partly found	@partly found
	40	50	not found	not found
	50	40	not found	not found
	60	30	not found, 2 separated phases	not found, 2 separated phases
	70	20	not found, 2 separated phases	not found, 2 separated phases
15	10	75	found	&found
	20	65	&found	&found
	30	55	&found	&found
	40	45	&found	&found
	50	35	&found	@partly found

Table A.1. (continued)

Component (%w/w)			Liquid crystal formation	
B72	**A**	**W**	**At 7 days**	**At 2 months**
15	60	25	[&]found	[@]partly found
	70	15	[@]partly found	[@]partly found
			2 separated phases	2 separated phases
20	10	70	[&]found	[&]found
	20	60	[&]found	[@]partly found
	30	50	[&]found	[&]found
	40	40	[&]found	[&]found
	50	30	[&]found	[&]found
	60	20	[&]found	[&]found
	70	10	[&]found	[&]found
25	10	65	[&]found	[&]found
	20	55	[&]found	[&]found
	30	45	[&]found	[&]found
	40	35	[&]found	[&]found
	50	25	[&]found	[&]found
	60	15	[&]found	[&]found
	70	5	[&]found	[&]found
30	10	60	[&]found	[&]found
	20	50	[&]found	[&]found
	30	40	[&]found	[&]found
	40	30	[&]found	[&]found
	50	20	[&]found	[&]found
	60	10	[&]found	[&]found

[&] similar to Figure 1 in Appendix B

[@] similar to Figure 2 in Appendix B

Table A.2. Liquid Crystal Formation from Brij®72 (B72), Isopropyl Myristate (IPM) and Water (W)

Component (%w/w)			Liquid crystal formation	
B72	**IPM**	**W**	**At 7 days**	**At 2 months**
5	10	85	@partly found	@partly found
	20	75	not found	not found
	30	65	not found	not found
	40	55	not found, 2 separated phases	not found, 2 separated phases
	50	45	not found	not found, 2 separated phases
	60	35	not found	not found, 2 separated phases
	70	25	not found	not found, 2 separated phases
	80	15	not found, 2 separated phases	not found, 2 separated phases
10	10	80	&found	&found
	20	70	not found	not found
	30	60	not found	not found
	40	50	not found	not found
	50	40	not found	not found, 2 separated phases
	60	30	not found, 2 separated phases	not found, 2 separated phases
	70	20	not found	not found
	80	10	not found, 2 separated phases	not found, 2 separated phases
15	10	75	&found	&found
	20	65	&found, 2 separated phases	&found, 2 separated phases
	30	55	not found	not found
	40	45	not found	not found
	50	35	not found, 2 separated phases	not found, 2 separated phases
	60	25	&found	&found

Table A.2. (continued)

Component (%w/w)			Liquid crystal formation	
B72	**IPM**	**W**	**At 7 days**	**At 2 months**
15	70	15	not found, 2 separated phases	not found, 2 separated phases
	80	5	not found, 2 separated phases	not found, 2 separated phases
20	10	70	[&]found	[&]found
	20	60	[&]found	[&]found
	30	50	[&]found, 2 separated phases	[&]found, 2 separated phases
	40	40	[&]found, 2 separated phases	[&]found, 2 separated phases
	50	30	[&]found, 2 separated phases	[&]found, 2 separated phases
	60	20	not found, 2 separated phases	not found, 2 separated phases
	70	10	not found, 2 separated phases	not found, 2 separated phases

[&] similar to Figure 1 in Appendix B

[@] similar to Figure 2 in Appendix B

Table A.3. Liquid Crystal Formation from Brij®72:Brij®721= (3:2) (S), Arlamol E (A) and Water (W)

Component (%w/w)			Liquid crystal formation	
S	**A**	**W**	**At 7 days**	**At 2 months**
5	10	85	not found	not found
	20	75	not found	not found
	30	65	not found	not found
	40	55	not found	not found
	50	45	not found	not found
	60	35	not found	not found
10	10	80	not found	not found
	20	70	not found	not found
	30	60	not found	not found
	40	50	not found	not found
	50	40	not found	not found
	60	30	not found	not found
	70	20	not found	not found
15	10	75	[&]found	[&]found
	20	65	partly found	not found
	30	55	not found	not found
	40	45	not found	not found
	50	35	not found	not found
	60	25	not found	not found
	70	15	not found, 2 separated phases	not found, 2 separated phases

[&] similar to Figure 1 in Appendix B

[@] similar to Figure 2 in Appendix B

Table A.4. Liquid Crystal Formation from Triethanolamine (T), Oleic acid (O) and Water (W)

Component (%w/w)			Liquid crystal formation	
T	**O**	**W**	**At 7 days**	**At 2 months**
5	10	85	not found, 2 separated phases	not found, 2 separated phases
	20	75	not found	not found, 2 separated phases
	30	65	not found	not found, 2 separated phases
	40	55	not found	not found, 2 separated phases
	50	45	not found, 2 separated phases	not found, 2 separated phases
	60	35	not found, 2 separated phases	not found, 2 separated phases
	70	25	not found, 2 separated phases	not found, 2 separated phases
	80	15	not found, 2 separated phases	not found, 2 separated phases
10	10	80	not found	not found
	20	70	not found	not found
	30	60	not found	partly found
	40	50	☹partly found	☹partly found
	50	40	found (Figure B.3)	*found
	60	30	*found	not found
	70	20	*found	not found
	80	10	not found	not found
15	10	75	not found	not found
	20	65	☹found	found
	30	55	*found	found
	40	45	☹partly found	☹found
	50	35	found (Figure B.4)	☹found
	60	25	☹found	not found

Table A.4. (continued)

Component (%w/w)			Liquid crystal formation	
T	**O**	**W**	**At 7 days**	**At 2 months**
15	70	15	found	found (Figure B.5)
	80	5	found	found
20	10	70	not found	not found
	20	60	partly found	found
	30	50	found, 2 separated phases	found
	40	40	found, 2 separated phases	found (Figure B.6)
	50	30	found, 2 separated phases	found
	60	20	found (Figure B.7), 2 separated phases	found (Figure B.7)
	70	10	found, 2 separated phases	found (Figure B.8)
25	10	65	not found	not found
	20	55	not found	not found
	30	45	found	found
	40	35	found	found
	50	25	found	found (Figure B.9)
	60	15	found	found
	70	5	found	found
30	10	90	not found	not found
	20	50	not found	not found

Table A.4. (continued)

Component (%w/w)			Liquid crystal formation	
T	**O**	**W**	**At 7 days**	**At 2 months**
30	30	40	*found	*found
	40	30	*found	*found
	50	20	☹found, 2 separated phases	found
	60	10	☹found, 2 separated phases	found

* similar to Figure B.3 in Appendix B

☹ similar to Figure B.4 in Appendix B

similar to Figure B.5 in Appendix B

similar to Figure B.6 in Appendix B

similar to Figure B.8 in Appendix B

Table A.5. Liquid Crystal Formation from Sodium Dodecyl Sulfate (SDS), Decanol (1) and Water (W)

Component (%w/w)			Liquid crystal formation	
SDS	**D**	**W**	**At 7 days**	**At 2 months**
5	10	85	found (Figure B.10)	found
	20	75	found	found
	30	65	found	found
	40	55	not found, 2 separated phases	not found, 2 separated phases
	50	45	not found, 2 separated phases	not found, 2 separated phases
	60	35	not found, 2 separated phases	not found, 2 separated phases
10	10	80	found	found
	20	70	found	found
	30	60	found	found, 2 separated phases
	40	50	found (Figure B.13)	found (Figure B.14), 2 separated phases
	50	40	found	found, 2 separated phases
	60	30	partly found, 2 separated phases	found, 2 separated phases
	70	20	partly found, 2 separated phases	solution
	80	10	partly found, 2 separated phases	solution
20	10	70	found	solution
	20	60	found	found

Table A.5. (continued)

Component (%w/w)			Liquid crystal formation	
SDS	**D**	**W**	**At 7 days**	**At 2 months**
20	30	50	found (Figure 11)	❄found
	40	40	found (Figure B.12)	♥found, liquefied
	50	30	♥found, 2 separated phases	♋partly found, 2 separated phases
	60	20	♥found, 2 separated phases	♋partly found, 2 separated phases
	70	10	♥partly found, 2 separated phases	♋partly found, 2 separated phases
30	10	60	-	-
	20	50	❄found	❄found
	30	40	❄found	❄found
	40	30	☯found	🖫found
	50	20	⊕found	♁found
	60	10	⊕found	♁found

♥similar to Figure B.9 in Appendix B

🖫similar to Figure B.10 in Appendix B

❄similar to Figure B.11 in Appendix B

♋similar to Figure B.12 in Appendix B

☯similar to Figure B.13 in Appendix B

⊕similar to Figure B.14 in Appendix B

Table A.6. Liquid Crystal Formation from Lecithin and Water

Component (%w/w)		Liquid crystal formation	
Lecithin	**Water**	**At 7 days**	**At 2 months**
50	50	not found	not found
40	60	found (Figure C.15)	♣found
30	70	♣found	♣found
20	80	♣found, milky suspension	♣found, milky suspension
10	90	♣found, milky suspension	♣found, milky suspension

♣similar to Figure B.15 in Appendix B

APPENDIX B

The Microscopic Pattern under Polarized Light of the Liquid Crystalline Systems at Ambient Temperature

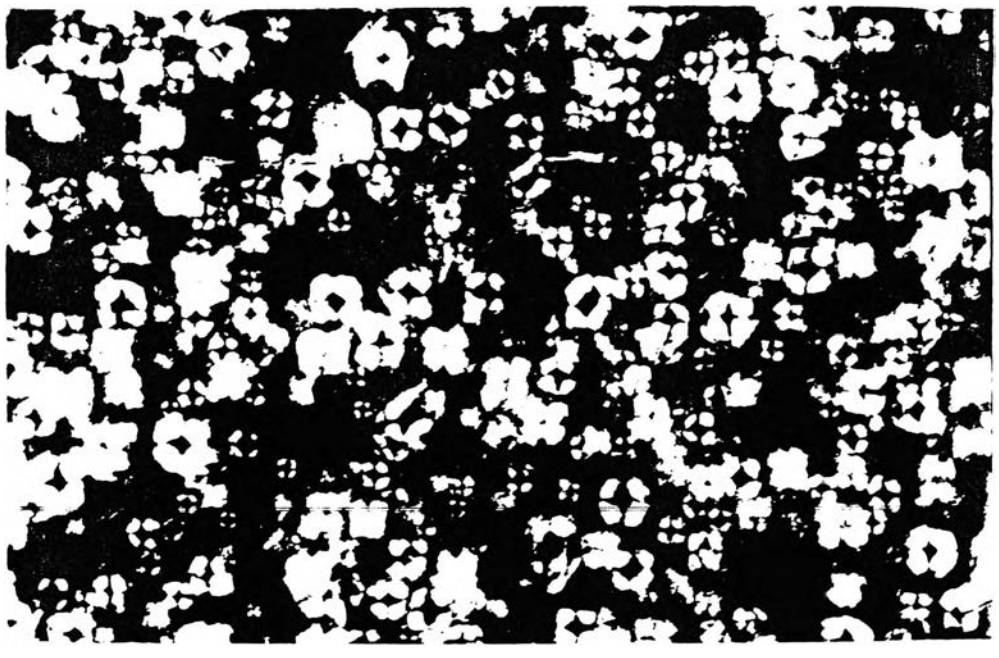


Figure B.1. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Brij®72:Arlamol®E:Water (15:10:75) at 3 Days.

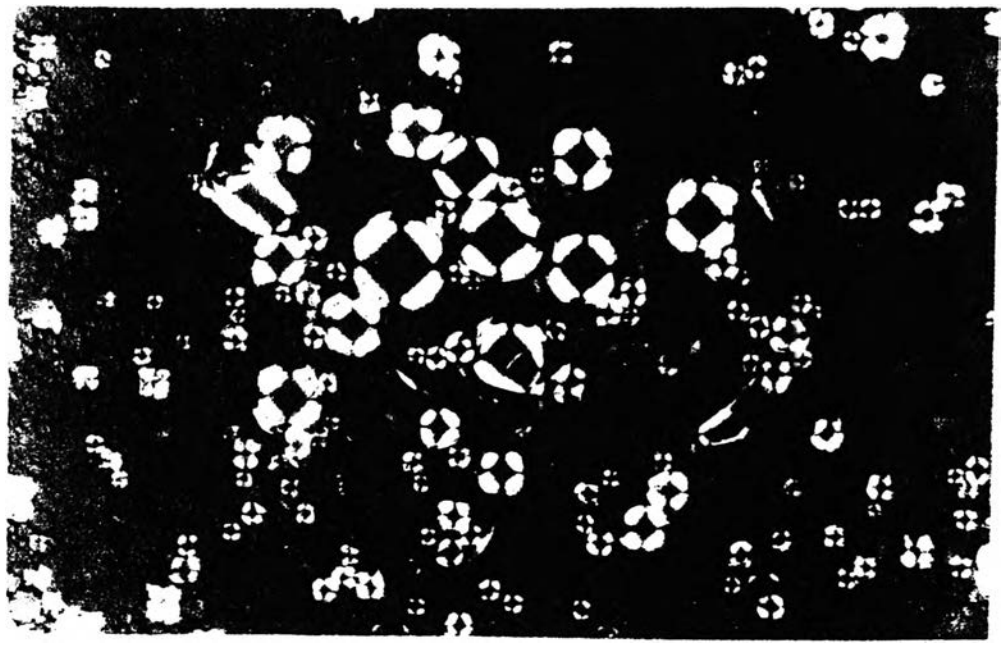


Figure B.2. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Brij®72:Arlamol®E:Water (15:10:75) With 5% Trehalose at 3 Days.

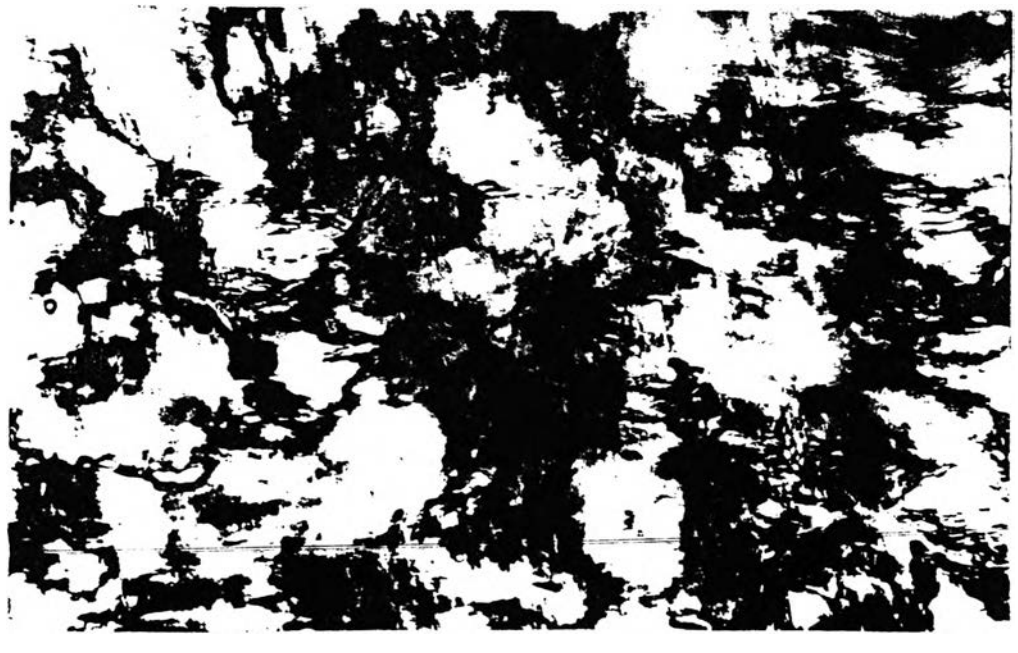


Figure B.3. Photomicrograph from Polarized Light Microscopy Showing the Hexagonal Structure of Triethanolamine:Oleic Acid:Water (10:50:40) at 3 Days.

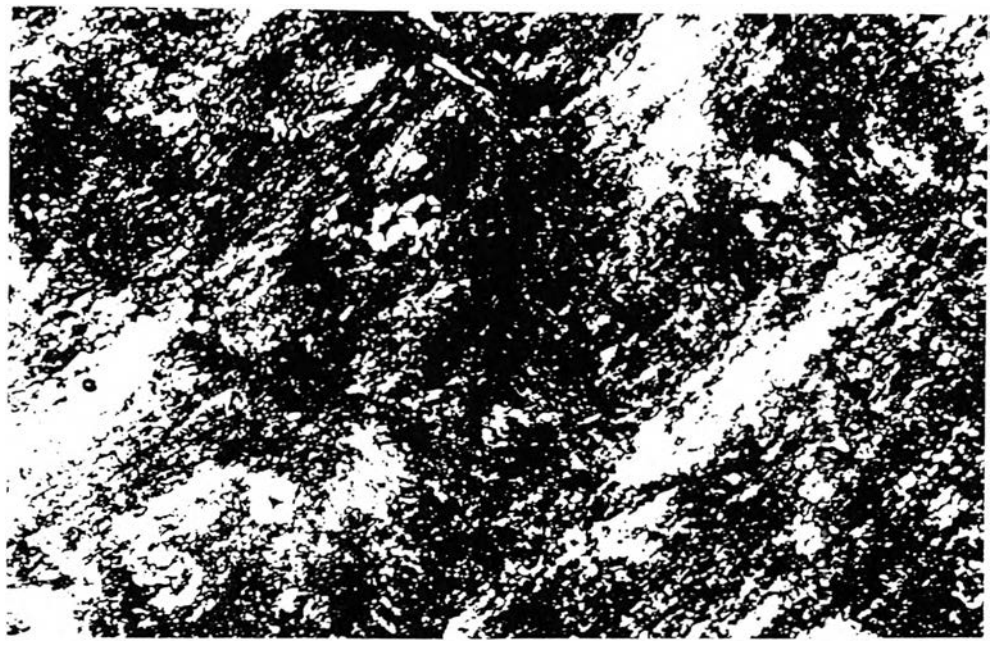


Figure B.4. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Triethanolamine:Oleic Acid:Water (15:50:35) at 3 Days.

Figure B.5. Photomicrograph from Polarized Light Microscopy Showing the Reverse Hexagonal Structure (Geraghty et al., 1996) of Triethanolamine:Oleic Acid:Water (15:70:15) at 3 Days.

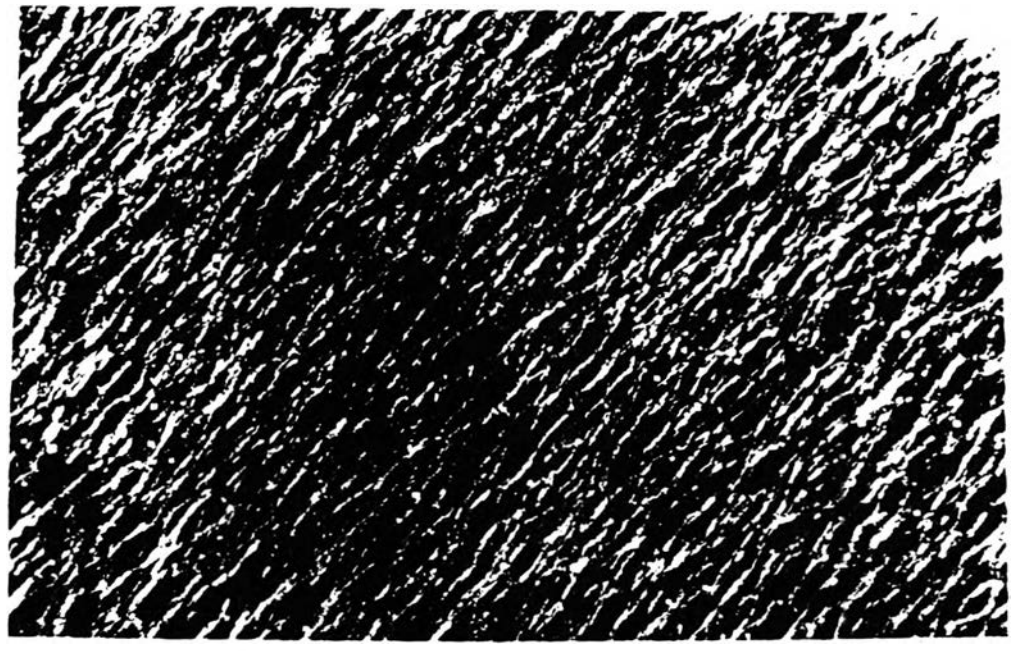


Figure B.6. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Triethanolamine:Oleic Acid:Water (20:40:40) at 2 months.

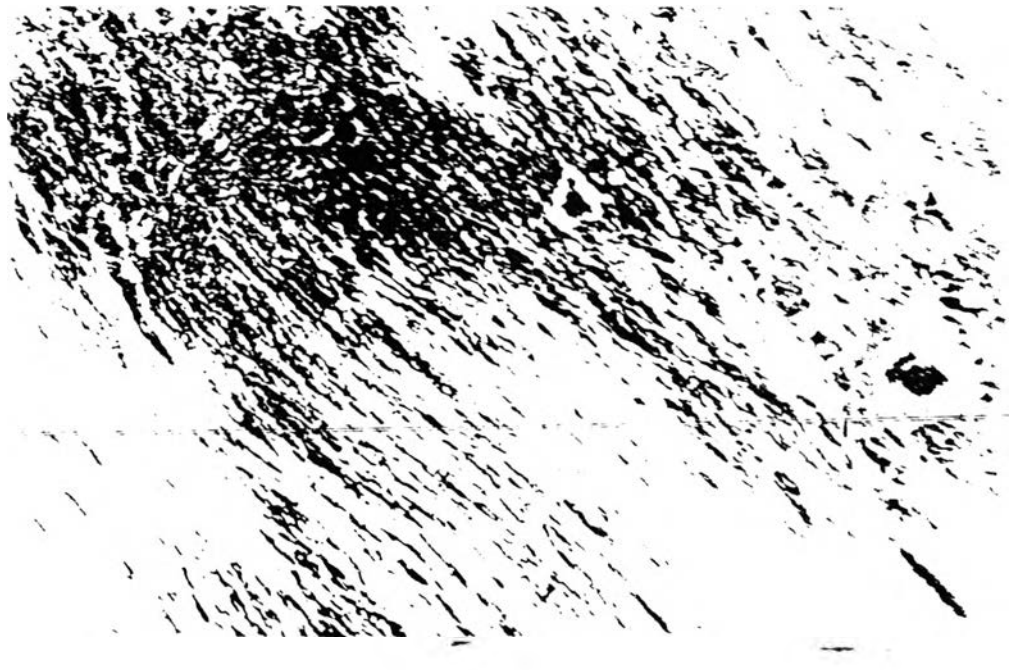


Figure B.7. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Triethanolamine:Oleic Acid:Water (20:60:20) at 3 Days.

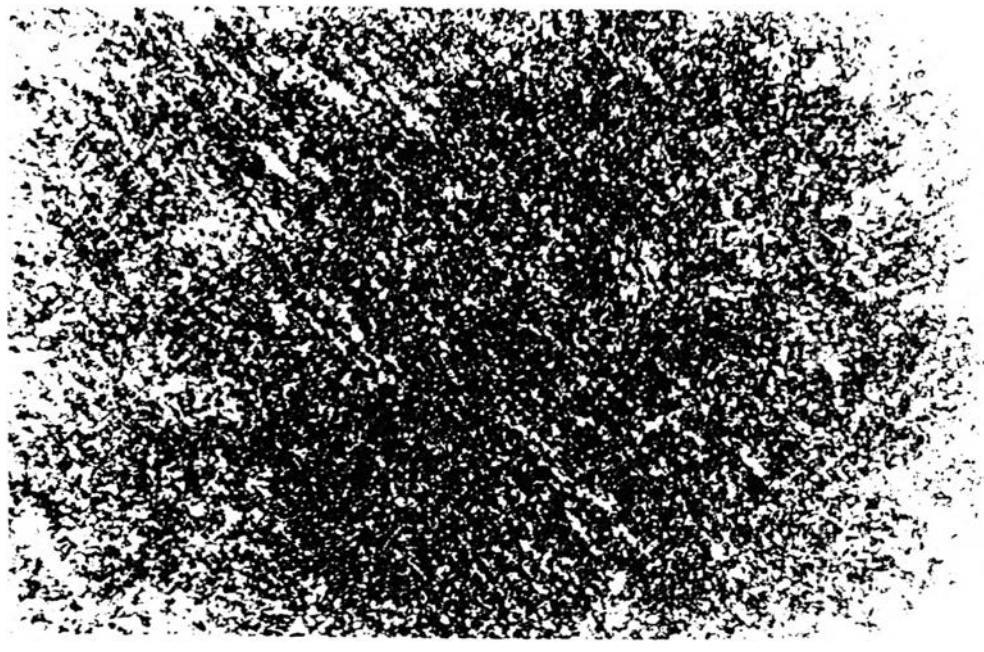


Figure B.8. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Triethanolamine:Oleic Acid:Water (20:70:10) at 2 Months.

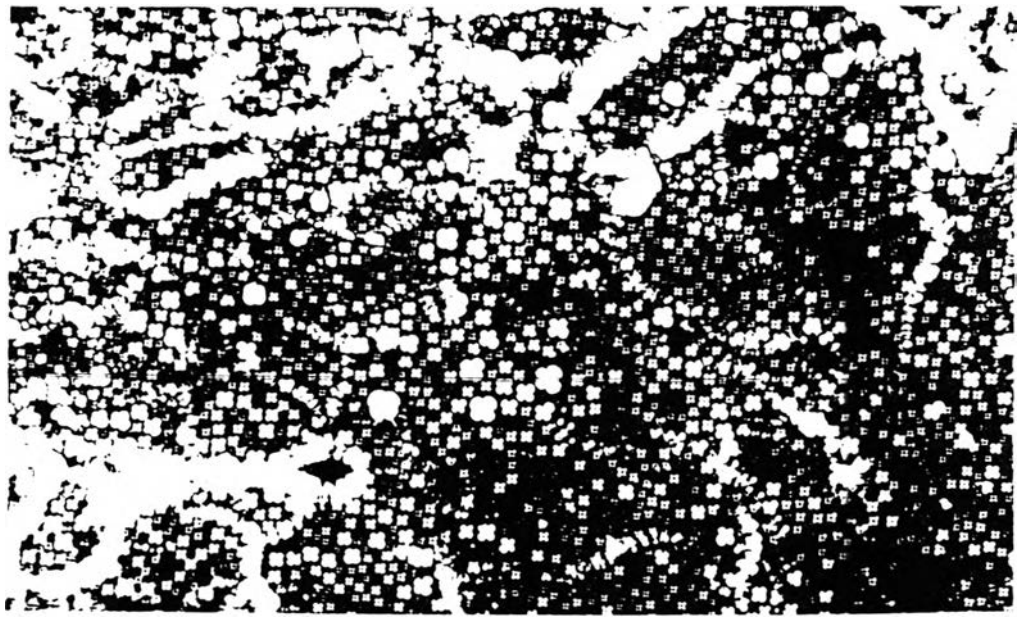


Figure B.9. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Triethanolamine:Oleic Acid:Water (25:50:25) at 2 Months.

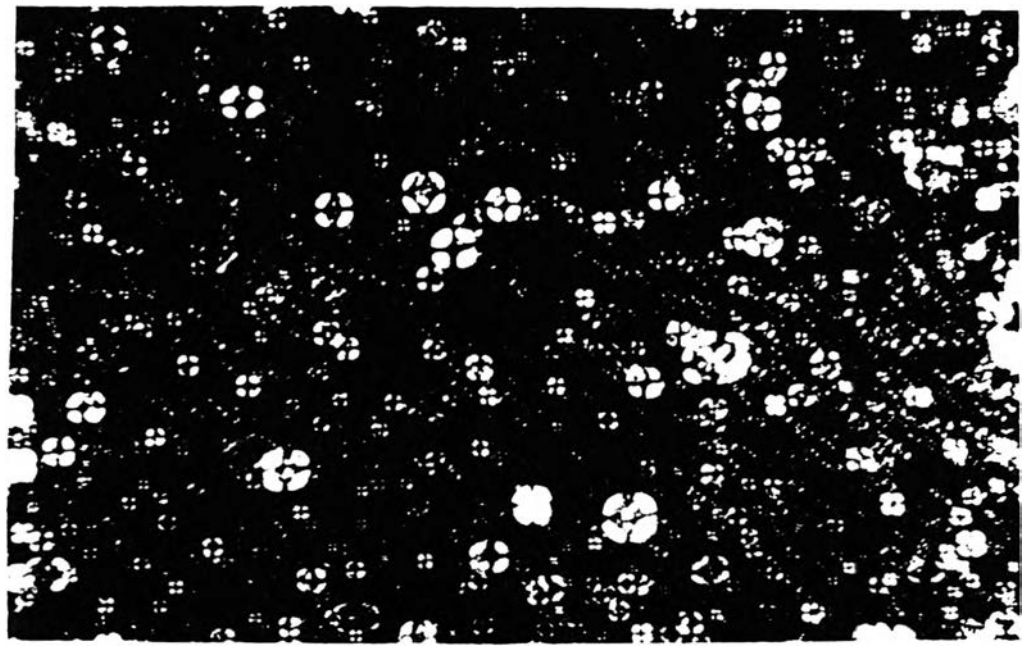


Figure B.10. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of SDS:Decanol:Water (5:10:85) at 3 Days.

Figure B.11. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of SDS:Decanol:Water (20:30:50) at 3 Days.

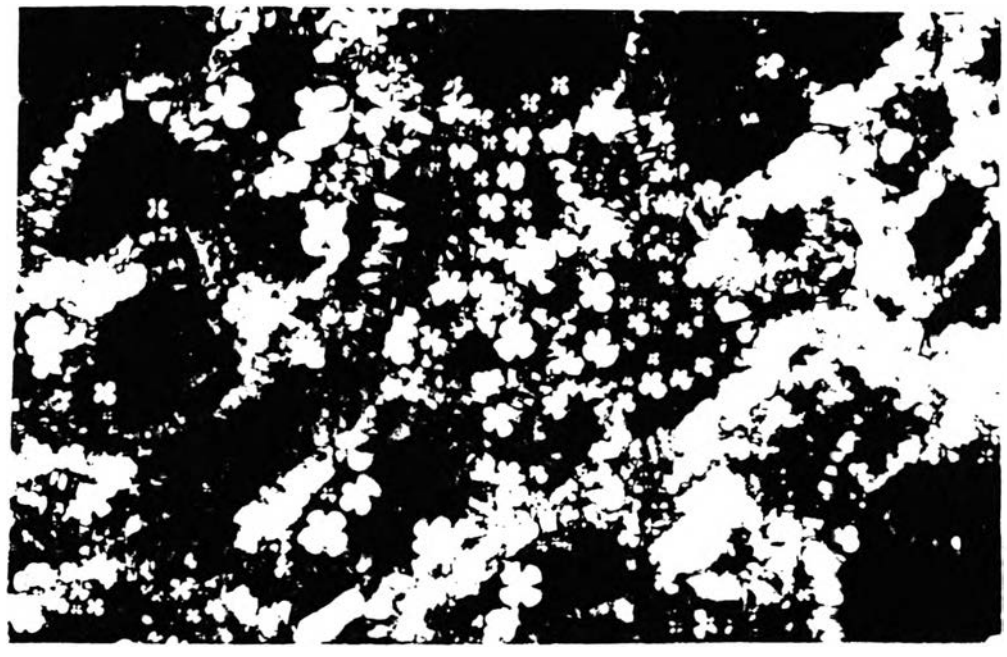


Figure B.12. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of SDS:Decanol:Water (20:40:40) at 3 Days.

Figure B.13. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of SDS:Decanol:Water (10:40:50) at 3 Days.

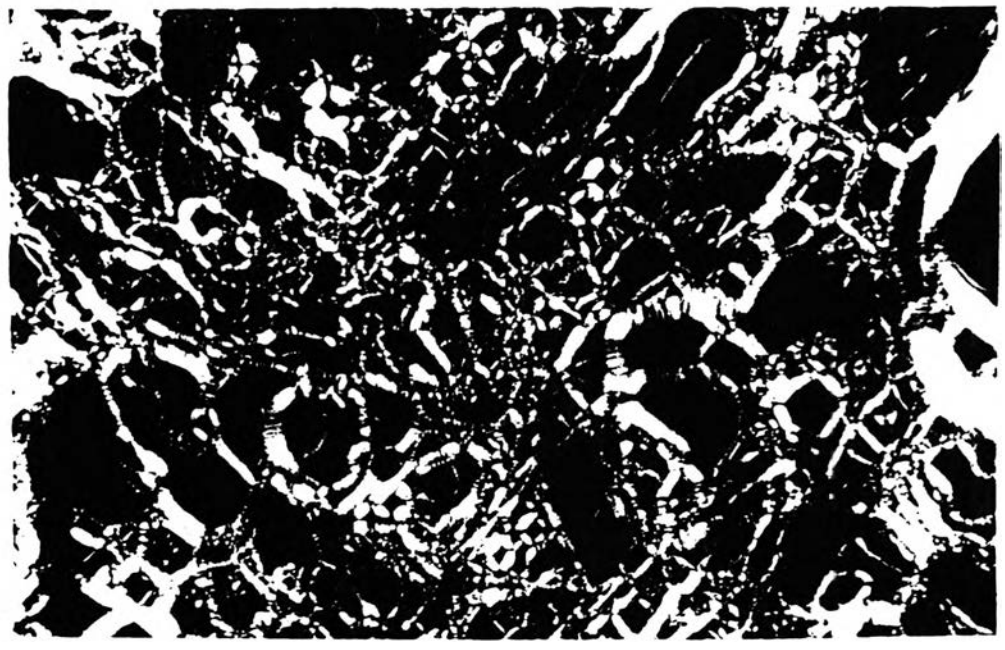


Figure B.14. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of SDS:Decanol:Water (10:40:50) at 2 months.

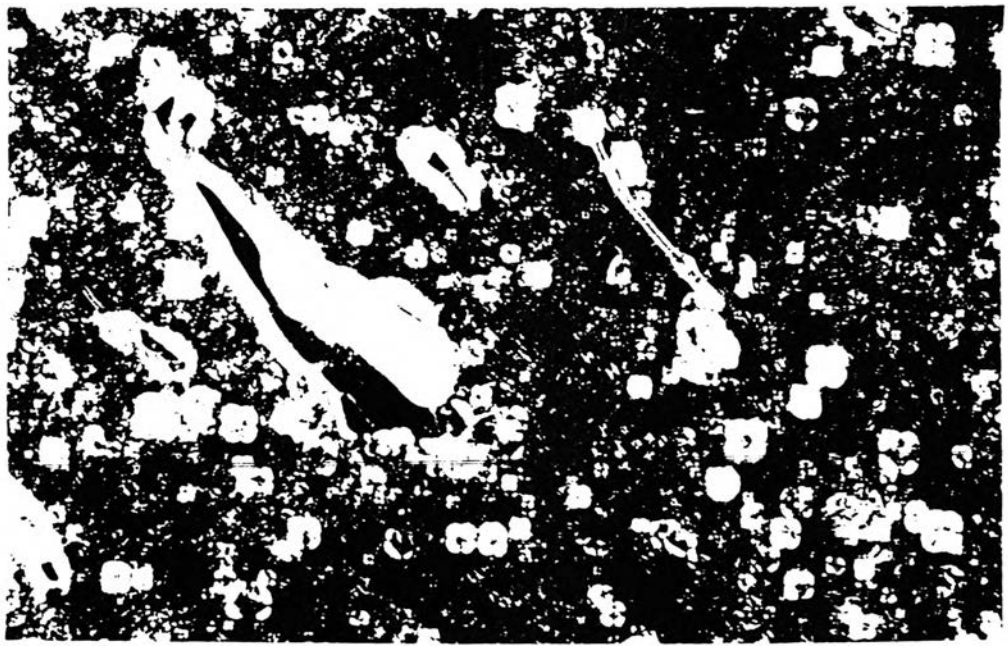


Figure B.15. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Lecithin:Water (40:60) at 3 Days.

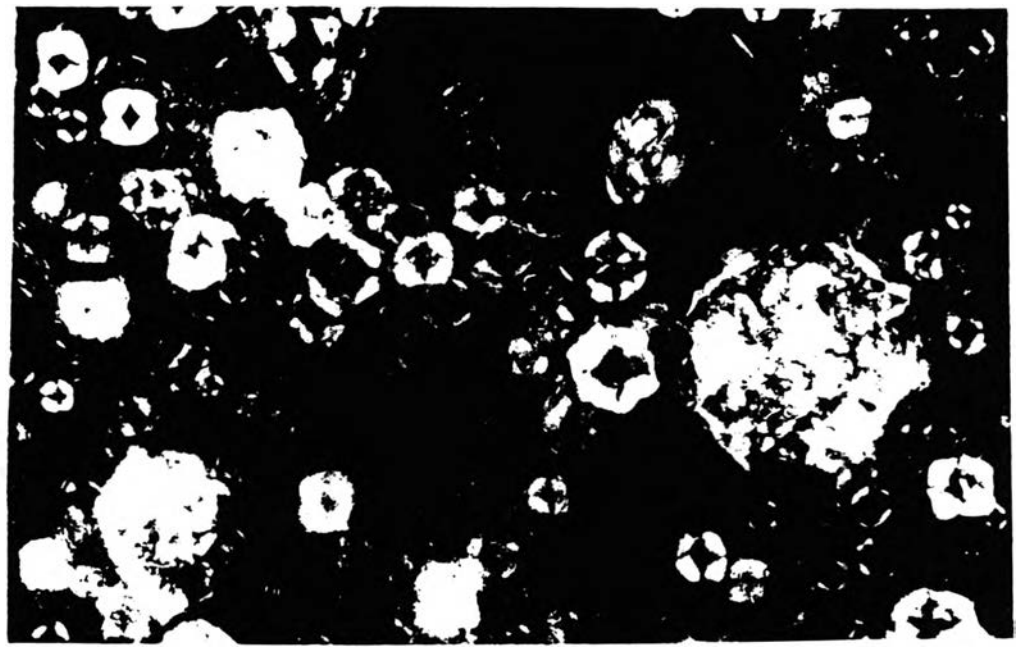


Figure B.16. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Brij®72:Arlamol®E:Water (15:10:75) With 6% Sodium Chloride at 3 Days.

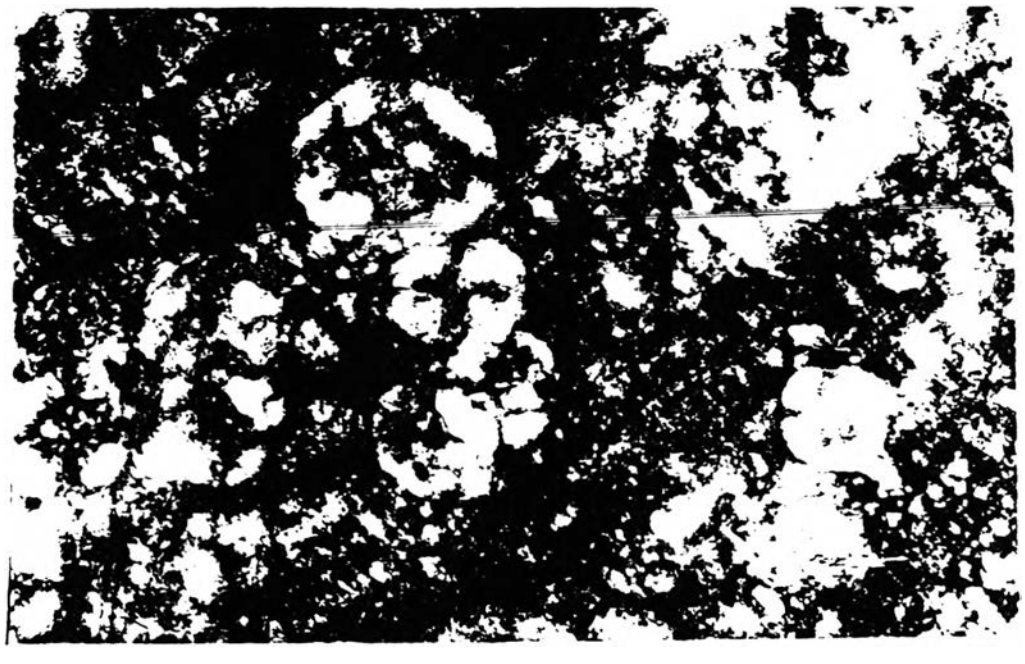


Figure B.17. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Lecithin:Water (40:60) With 10% urea at 3 Days.

Figure B.18. Photomicrograph from Polarized Light Microscopy Showing the Lamellar Structure of Triethanolamine:Oleic Acid:Water (25:30:45) With 1% Sodium Chloride at 2 Months.

APPENDIX C

Saturation Solubilities of Propylthiouracil (PTU) and Triamcinolone Acetonide (TA) in Different Liquid Crystalline Systems, Observed at 3 Days and 2 Months after Incorporation of the Drugs

Table C.1.

System (% w/w)	Structure	Solubility Ability		
		PTU		TA
		3 days	2 months*	
Brij®72:Arlamol®E:Water				
15:10:75	lamellar	0.2%	-	-
20:10:70	lamellar	0.3%	+	-
Triethanolamine:Oleic acid:Water				
10:50:45	hexagonal	0.60%	-	-
25:30:45	hexagonal	1.10%	-	-
15:50:35	lamellar	0.60%	-	-
SDS:Decanol:Water				
5:10:85	lamellar	0.20%	-	-
20:30:50	lamellar	0.20%	-	-
Lecithin:Water = 40:60	lamellar	0.50%	-	-
Liposomal system	lamellar	Table C.3.	-	-

* - = no crystal

\+ = crystals found

Table C.2. Calibration Curve for Assay the Amount of PTU in Liposome in Table C.3

Concentration (μg/ml)	1.52	3.04	4.56	6.08	7.60	9.12
Absorbance	0.136	0.276	0.406	0.551	0.679	0.809

$y = 0.0887x - 0.0043$; $R^2 = 0.9997$

Table C.3. The Results of Two Different Methods of Hydration on the Amount of PTU Encapsulated in 1 mL of Liposomal system

Hydration method	Amount in the system (μg/ml)	Pellet								Supernatant							
		Absorbance			Amount of PTU (μg/ml)			Mean	SD	Absorbance			Amount of PTU (μg/ml)			Mean	SD
		n_1	n_2	n_3	n_1	n_2	n_3			n_1	n_2	n_3	n_1	n_2	n_3		
Hydrated with distilled water	1,875	0.423	0.435	0.476	472	485	532	496.33	31.56	0.242	0.251	0.258	1340	1,390	1,430	1,386.67	45.09
Hydrated with 0.8 mg/mL PTU dissolved in distilled water	2,133.33	0.452	0.458	0.441	1262.5	1277.5	1230.0	1,256.67	24.28	0.769	0.820	0.802	862	920	899	893.67	29.36

Table C.4. Calibration Curve for Assay the Amount of PTU in Liposomal Pellets in Table C.5

Concentration (μg/mL)	1.52	3.04	4.56	6.08	7.60	9.12
Absorbance	0.135	0.280	0.422	0.562	0.712	0.873

$y = 0.0963x - 0.0153$; $R^2 = 0.9997$

Table C.5. Amount of PTU Encapsulated in Liposomal pellets (0.15 g)

Hydration method	Absorbance			Amount of PTU (μg/ml)			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3		
Hydrated with 0.8 mg/ mL PTU dissolved in distilled water	0.469	0.413	0.403	502	444	434	460	36.71

APPENDIX D

Effects of Additives on the Formation and Structures of the Liquid Crystalline Systems, Observed under Polarized Light Microscope

Table D.1. Observed at 3 Days

System (% w/w)	Additives	Conc.	Liquid crystal formation[+]	Physical appearance[+]
Brij®72:Arlamol®E	Trehalose	1, 3%	unchanged	unchanged
Water (15:10:75)		5, 10, 15%	partly found	unchanged
(Figure B.1)	Urea	10%	unchanged	unchanged
	NaCl	1, 3, 5%	unchanged	unchanged
		6,10, 15%	liquid crystal found in cluster (Figure B.16)	unchanged
	α-Tocopherol	1,3%	unchanged	unchanged
		5%	partly found	unchanged
		10%	not found	unchanged
Triethanolamine:	Trehalose	1, 3%	unchanged	unchanged
Oleic acid :Water		5, 10, 15%	unchanged	found
(10:50:40)		20%	not found	2 separated phases
(Figure B.3)	Urea	10%	☺changed	decreased viscosity
	NaCl	1, 3%	unchanged	coarse aggregate
		5%	unchanged	2 separated phases
	α-Tocopherol	3%	☺changed	decreased viscosity
		5, 10%	unchanged	mottled

Table D.1. (continued)

System (% w/w)	Additives	Conc.	Liquid crystal formation[+]	Physical appearance[+]
Triethanolamine:	Trehalose	1, 3, 5, 10%	unchanged	unchanged
Oleic acid :Water		15, 20%	unchanged	unchanged
(25:30:45)		30%	partly found	unchanged
(*Figure B.3)	Urea	10%	unchanged	unchanged
	NaCl	1%	unchanged	unchanged
		3%	not found	liquefied
	α-Tocopherol	10%	unchanged	unchanged
		15%	☹changed	liquefied
Triethanolamine:	Trehalose	1, 3, 5, 10%	unchanged	unchanged
Oleic acid :Water		15%	unchanged	unchanged
(15:50:35)		20%	partly found	unchanged
(Figure B.4)	Urea	10%	unchanged	unchanged
	NaCl	1%	unchanged	unchanged
		3%	partly found	separated water phase
	α-Tocopherol	1, 3, 5%	unchanged	unchanged
		10, 15%	*changed	increased viscosity

Table D.1. (continued)

System (% w/w)	Additives	Conc.	Liquid crystal formation[+]	Physical appearance[+]
SDS:Decanol:	Trehalose	1%	not found	unchanged
Water (5:10:85)	Urea	10%	not found	unchanged
(Figure B.10)	NaCl	1%	not found	liquefied
	α-Tocopherol	1%	unchanged	unchanged
		3,5%	partly found	unchanged
		10%	not found	unchanged
Sodium Dodecyl	Trehalose	1, 3, 5, 10%	unchanged	unchanged
Sulfate:Decanol:		15, 20%	unchanged	unchanged
Water (20:30:50)	Urea	10%	unchanged	unchanged
(Figure B.11)	NaCl	1%	unchanged	unchanged
		3%	not found	changed from translucent to opaque
	α-Tocopherol	1, 3, 5%	unchanged	unchanged
		10%	unchanged	liquefied, 2 separated phases
Lecithin:Water	Trehalose	1, 3, 5, 10%	unchanged	unchanged
(40:60)		15, 20%	unchanged	unchanged
(Figure B.15)		30%	partly found	gritty
	Urea	10%	found (Figure 17)	increased viscosity
	NaCl	1, 3, 5, 10%	[#]found	increased viscosity
		15%	[#]found	decreased viscosity
	α-Tocopherol	1, 3, 5%	unchanged	increased viscosity
		10%	not found	unchanged

Table D.1. (continued)

System (% w/w)	Additives	Conc.	Liquid crystal formation[+]	Physical appearance[+]
Liposomal system	Trehalose	5%	unchanged	unchanged
		10%	vesicles with incomplete annealing	unchanged
	Urea	10%	unchanged	unchanged
	NaCl	1%	vesicles with incomplete annealing	2 separated phases
	α-Tocopherol	1%	unchanged	unchanged
		3%	vesicles with incomplete annealing	

[+] compared to the system without the additive

[*] similar to Figure B.3 in Appendix B

[☺] similar to Figure B.4 in Appendix B

[#] similar to Figure B.17 in Appendix B

Table D.2. Observed at 2 Months

System (% w/w)	Additives	Conc.	Liquid crystal formation[$]	Physical appearance[$]
Brij®72:Arlamol®E	Trehalose	3%	partly found	unchanged
Water (15:10:75)	Urea	10%	partly found	unchanged
(Figure B.1)	NaCl	6%	unchanged	unchanged
	α-Tocopherol	3%	partly found	unchanged
Triethanolamine:	Urea	10%	unchanged	unchanged
Oleic acid :Water				
(10:50:40)				
(Figure B.3)				
Triethanolamine:	Trehalose	25%	not found	unchanged
Oleic acid :Water	Urea	10%	unchanged	unchanged
(25:30:45)	NaCl	1%	partly found	unchanged
(*Figure B.3)	α-Tocopherol	10%	♥changed	liquefied
Triethanolamine:	Trehalose	10%	unchanged	unchanged
Oleic acid :Water	Urea	10%	unchanged	unchanged
(15:50:35)	NaCl	1%	unchanged	unchanged
(Figure B.4)	α-Tocopherol	15%	unchanged	unchanged
SDS:Decanol:	α-Tocopherol	1%	♥changed	2 separated phases
Water (5:10:85)				
(Figure B.10)				

Table D.2. continued

System (% w/w)	Additives	Conc.	Liquid crystal formation[$]	Physical appearance[$]
Sodium Dodecyl Sulfate:Decanol: Water (20:30:50) (Figure B.11)	Trehalose	20%	unchanged	unchanged
	Urea	10%	unchanged	unchanged
	NaCl	1%	unchanged	unchanged
	α-Tocopherol	5%	unchanged	liquified, coalescence of α-tocopherol
Lecithin:Water (40:60) (Figure B.15)	Trehalose	20%	unchanged	unchanged
	Urea	10%	unchanged	unchanged
	NaCl	9%	unchanged	unchanged
	α-Tocopherol	5%	unchanged	unchanged
Liposomal system	Trehalose	5%	unchanged	unchanged
	Urea	10%	unchanged	unchanged
	NaCl	-	-	-
	α-Tocopherol	1%	unchanged	unchanged

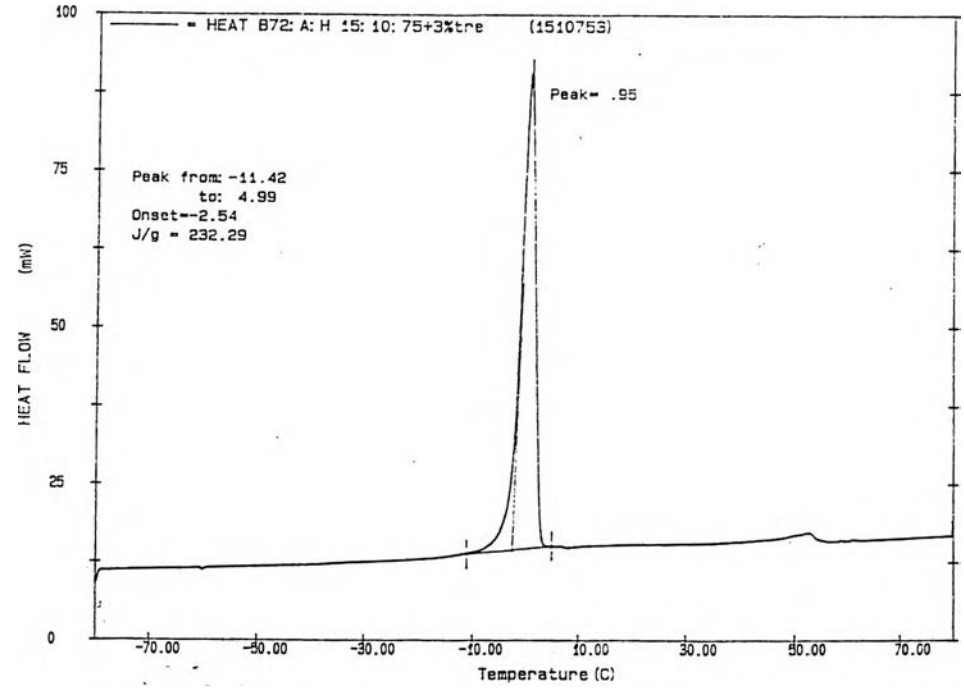
$ compared to the system at 3 Days

* similar to Figure B.3 in Appendix B

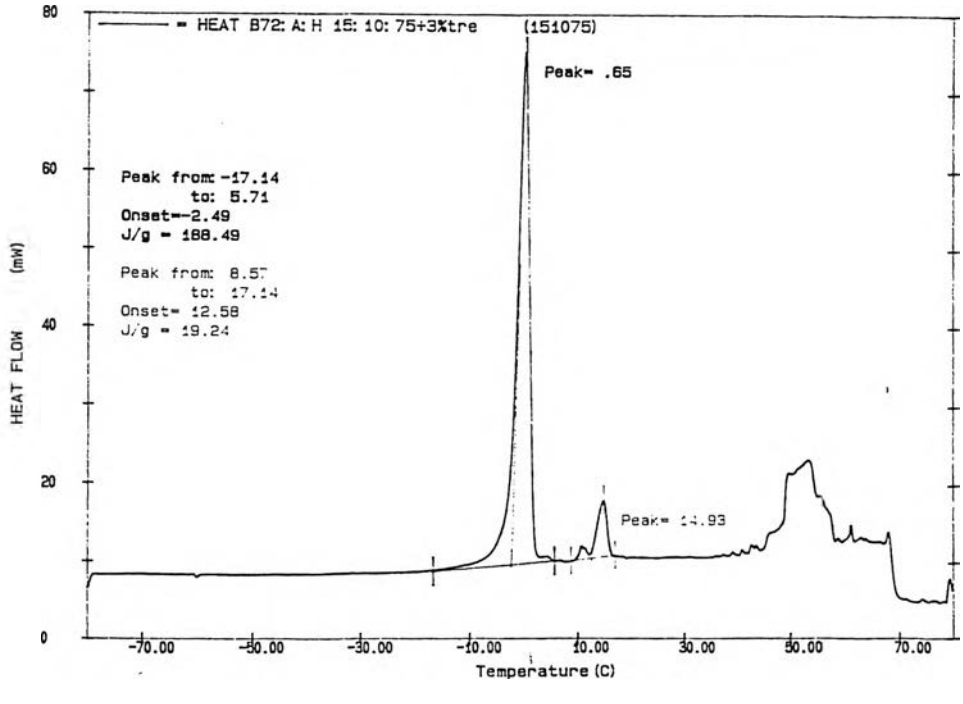
♥ similar to Figure B.9 in Appendix B

APPENDIX E

DSC Thermograms of the Liquid Crystalline Systems with Additives and PTU, 3 Days and 2 Months after Preparation.

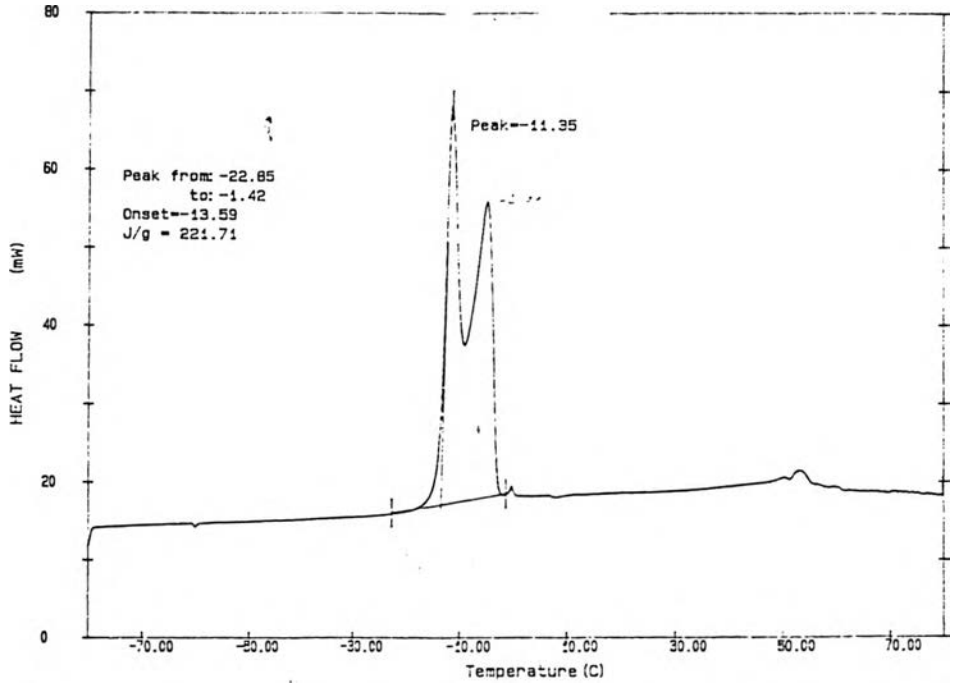


(a)

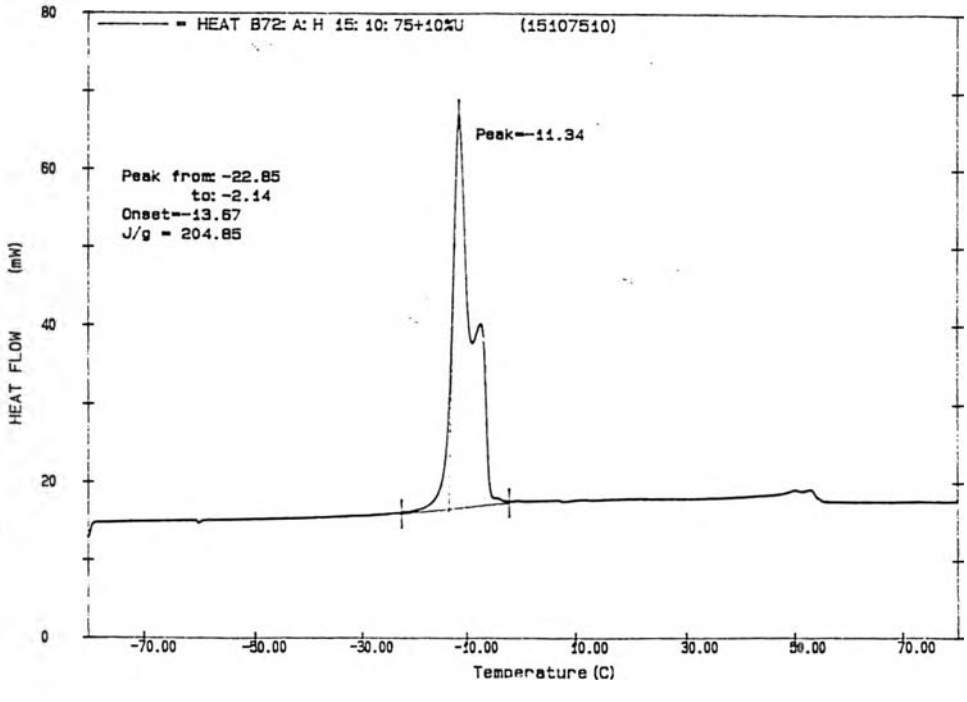


(b)

Figure E.1. DSC Thermograms of the Liquid Crystalline Systems Composed of Brij®72:Arlamol®E:Water (15:10:75) With 3% Trehalose (a) at 3 Days (b) at 2 Months.

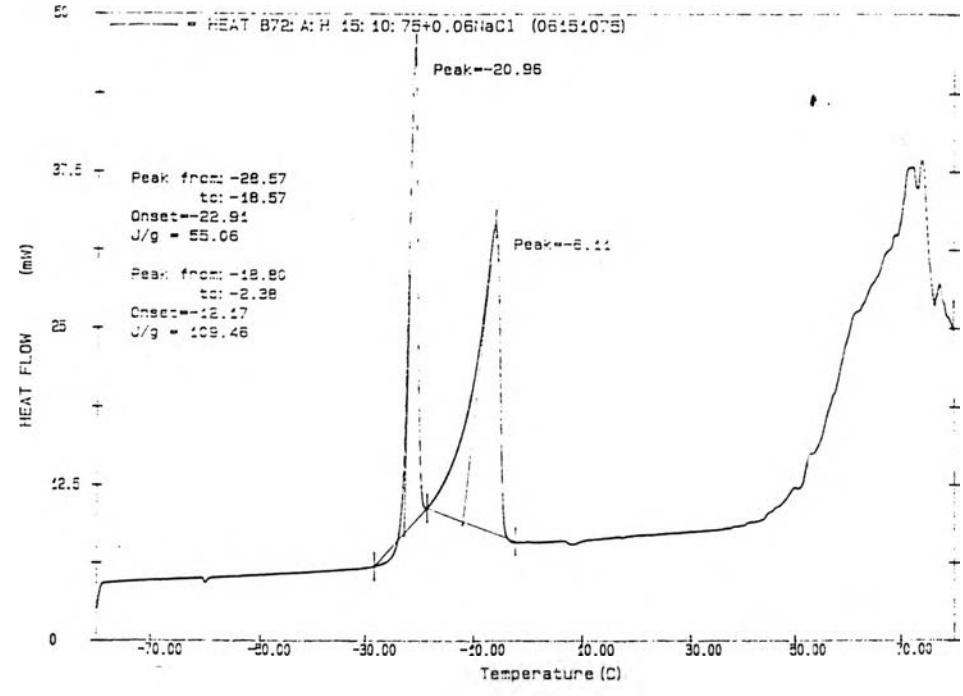


(a)

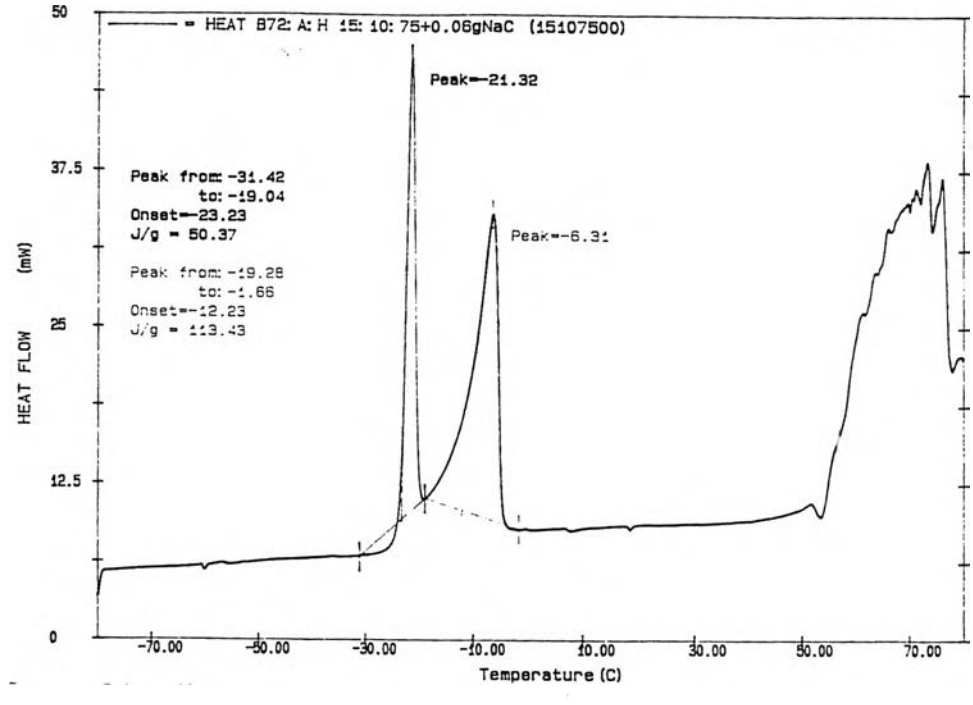


(b)

Figure E.2. DSC Thermograms of the Liquid Crystalline Systems Composed of Brij®72:Arlamol®E:Water (15:10:75) With 10% Urea (a) at 3 Days (b) at 2 Months.

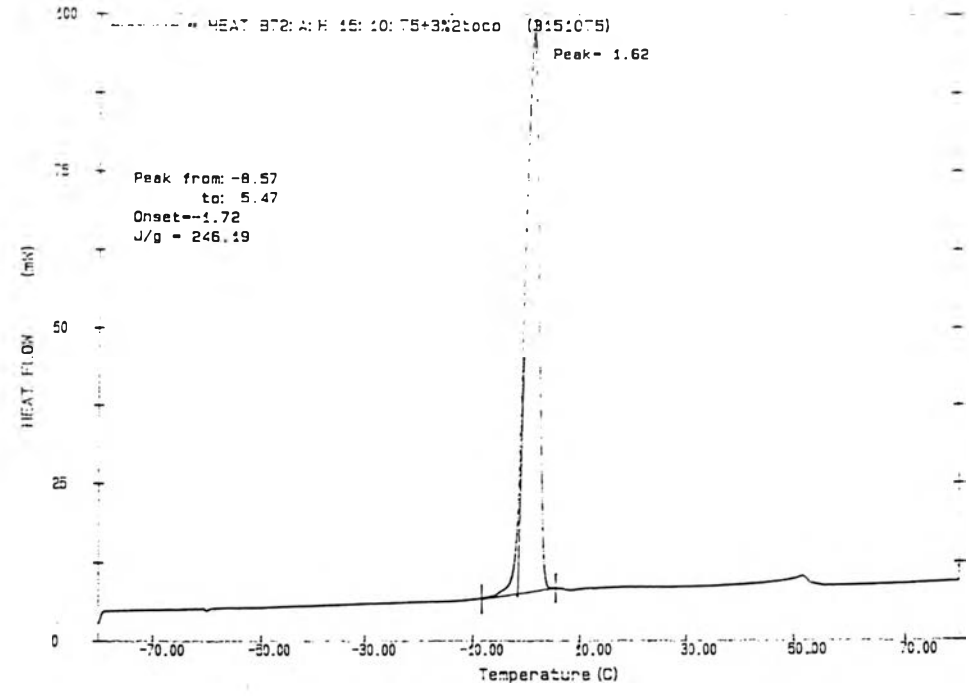


(a)

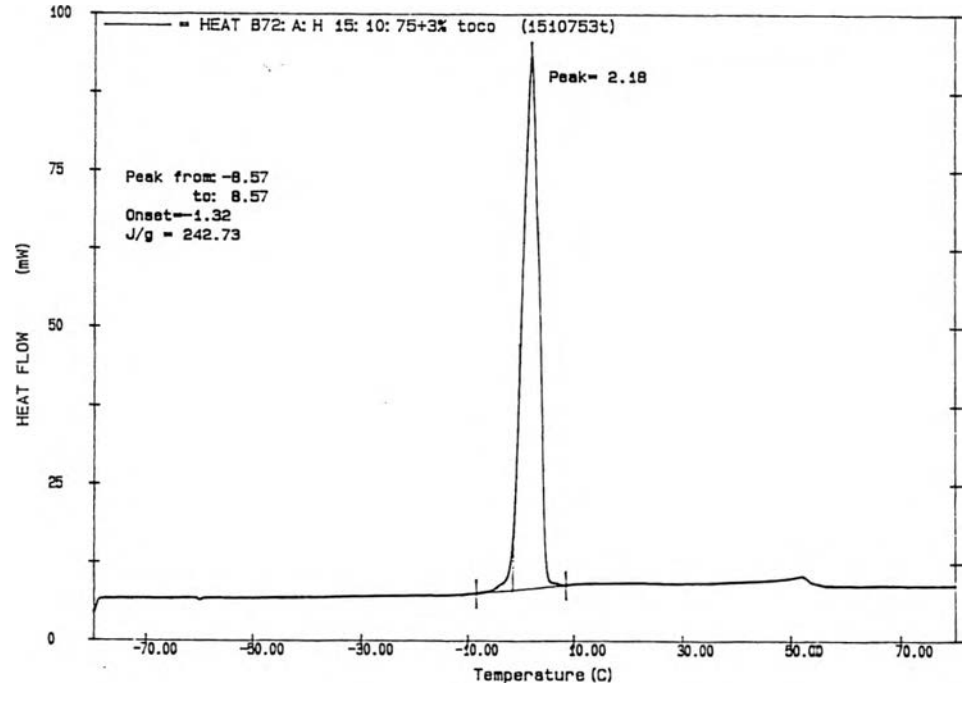


(b)

Figure E.3. DSC Thermograms of the Liquid Crystalline Systems Composed of Brij®72:Arlamol®E:Water (15:10:75) With 6% Sodium Chloride (a) at 3 Days (b) at 2 Months.

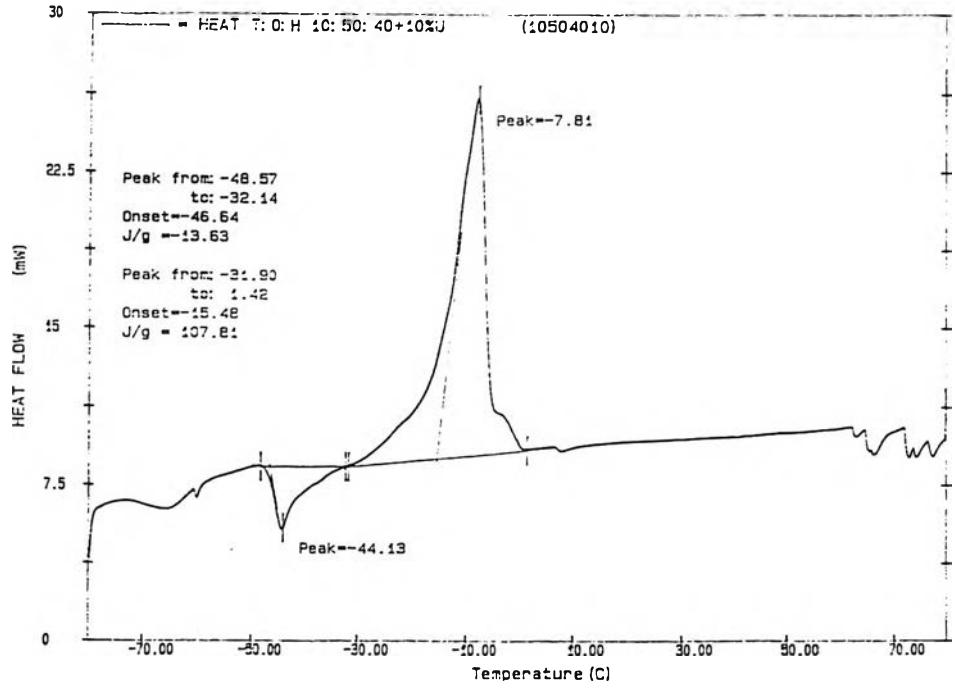


(a)

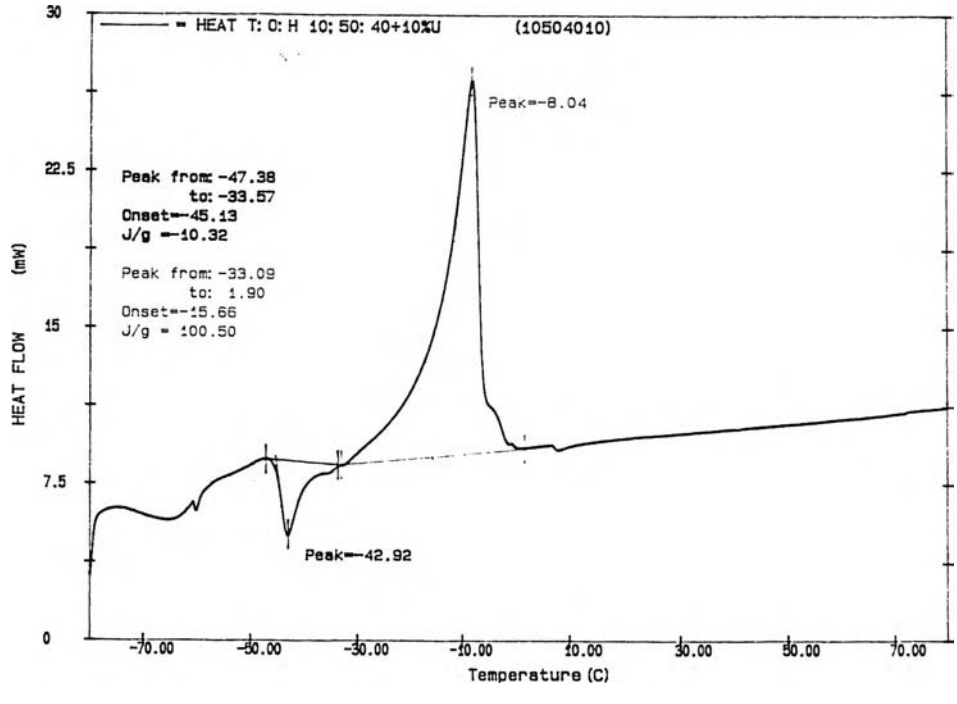


(b)

Figure E.4. DSC Thermograms of the Liquid Crystalline Systems Composed of Brij®72:Arlamol®E:Water (15:10:75) With 3% α-Tocopherol (a) at 3 Days (b) at 2 Months.

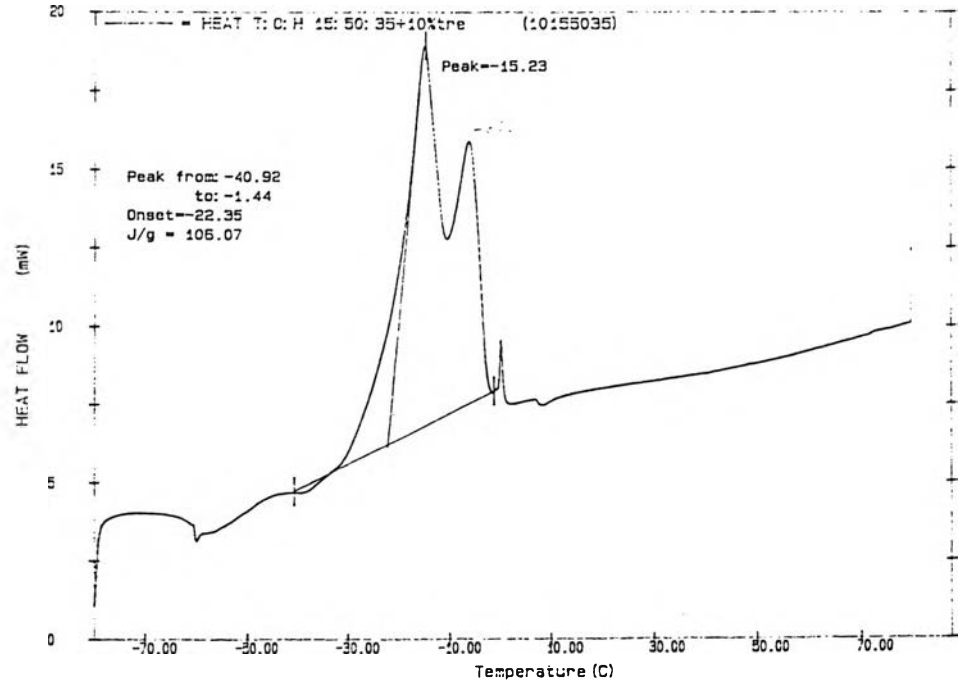


(a)

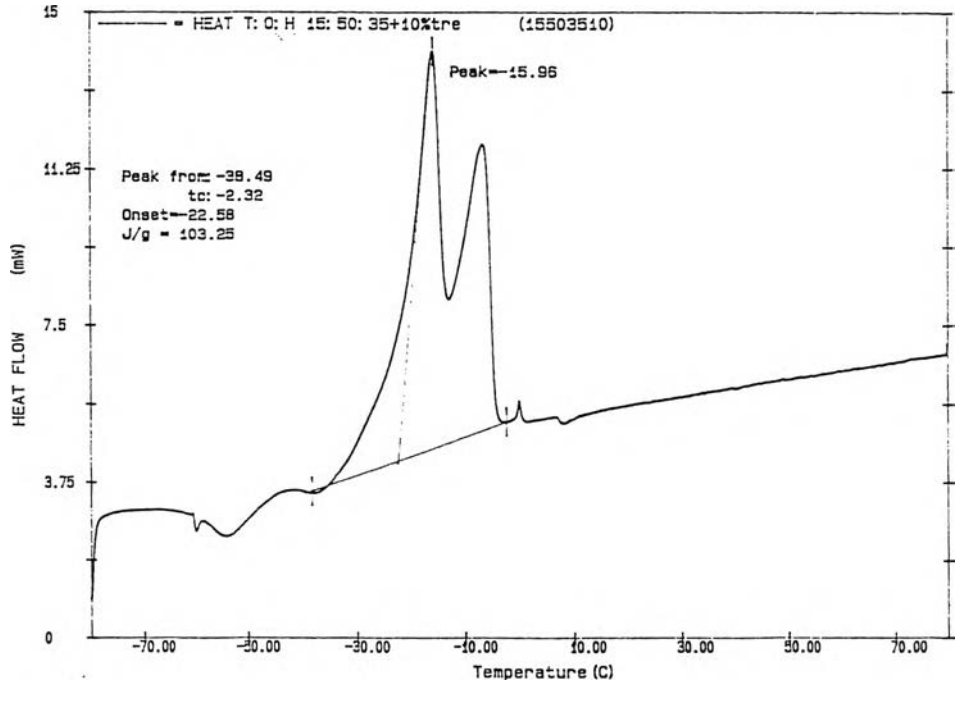


(b)

Figure E.5. DSC Thermograms of the Liquid Crystalline Systems Composed of Triethanolamine:Oleic Acid:Water (10:50:40) With 10% Urea (a) at 3 Days (b) at 2 Months.

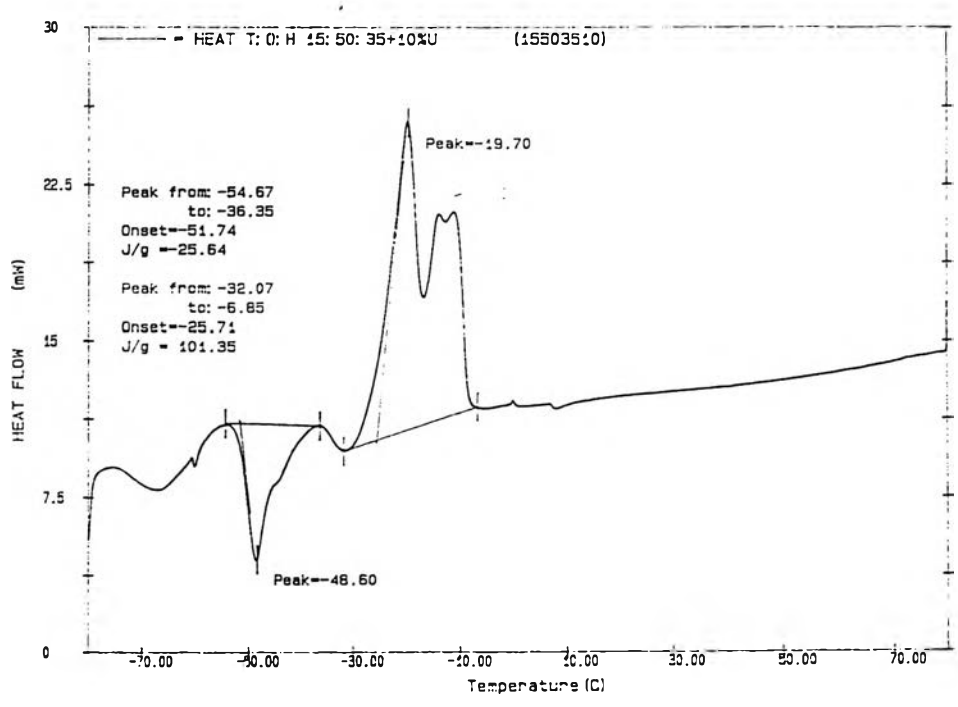


(a)

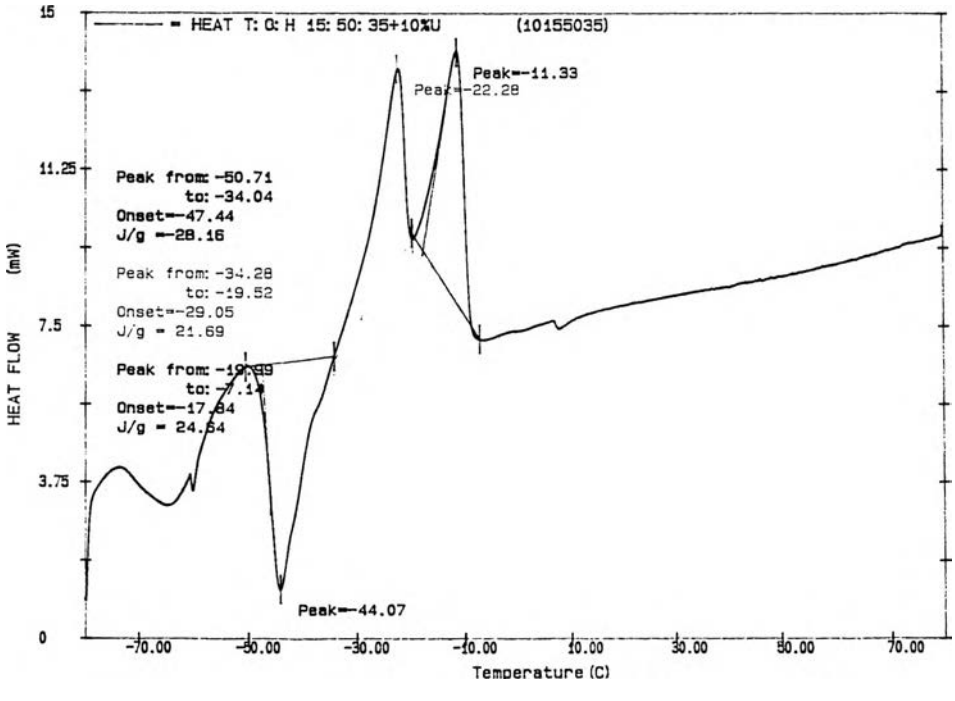


(b)

Figure E.6. DSC Thermograms of the Liquid Crystalline Systems Composed of Triethanolamine:Oleic Acid:Water (15:50:35) With 10% Trehalose (a) at 3 Days (b) at 2 Months.

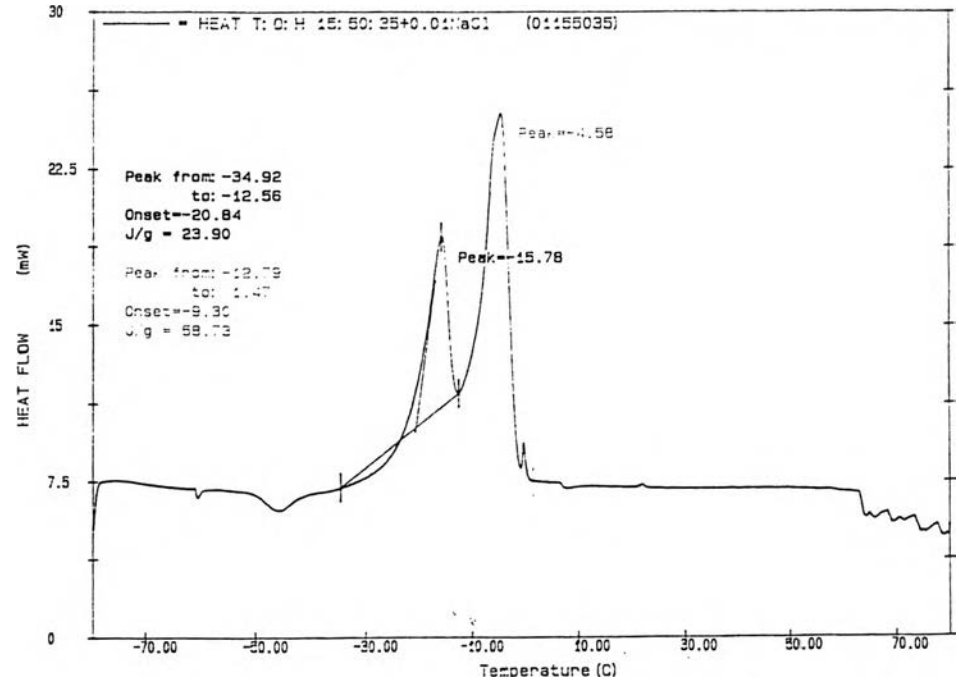


(a)

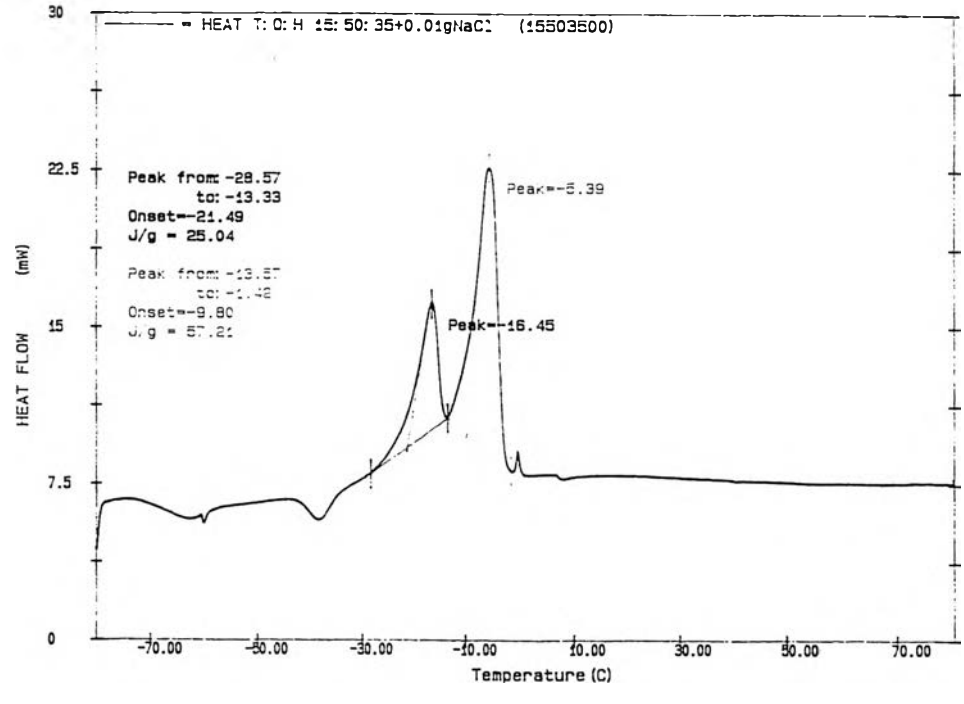


(b)

Figure E.7. DSC Thermograms of the Liquid Crystalline Systems Composed of Triethanolamine:Oleic Acid:Water (15:50:35) With 10% Urea (a) at 3 Days (b) at 2 Months.

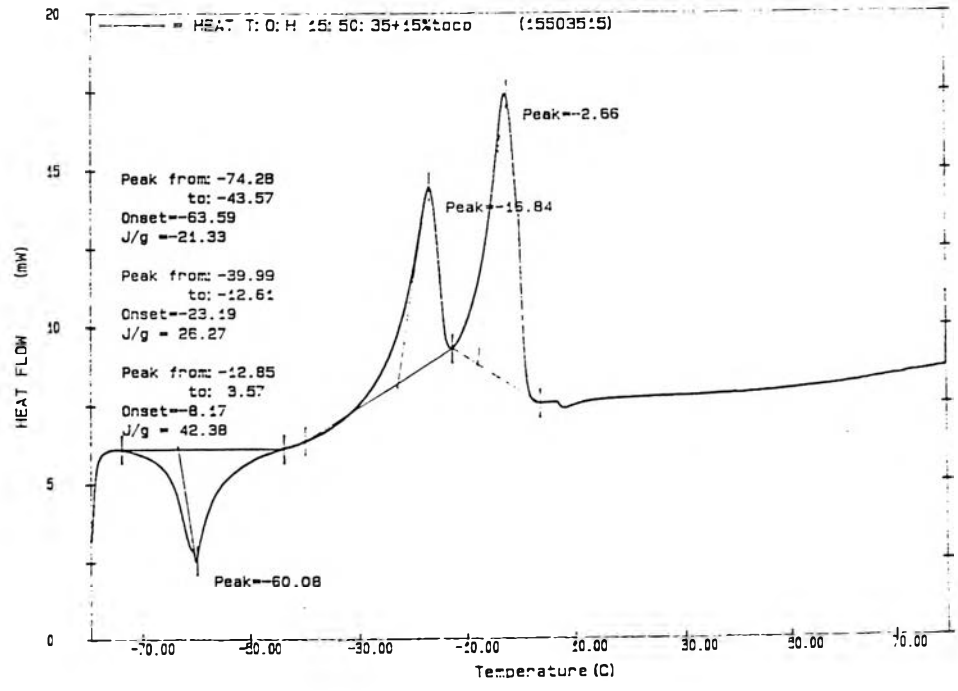


(a)

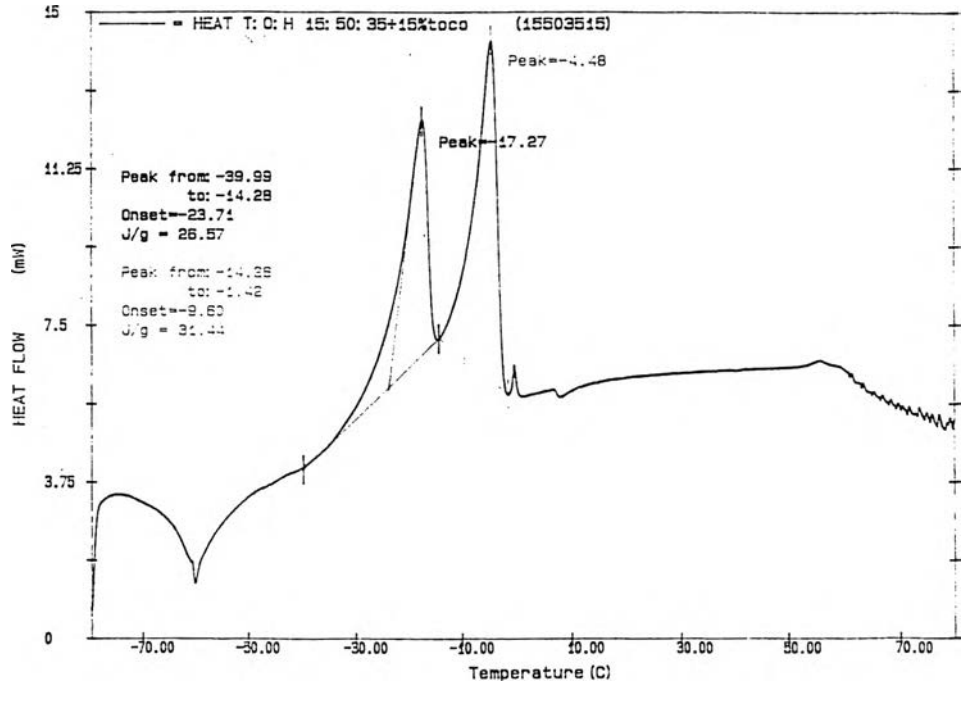


(b)

Figure E.8. DSC Thermograms of the Liquid Crystalline Systems Composed of Triethanolamine:Oleic Acid:Water (15:50:35) With 1% Sodium Chloride (a) at 3 Days (b) at 2 Months.

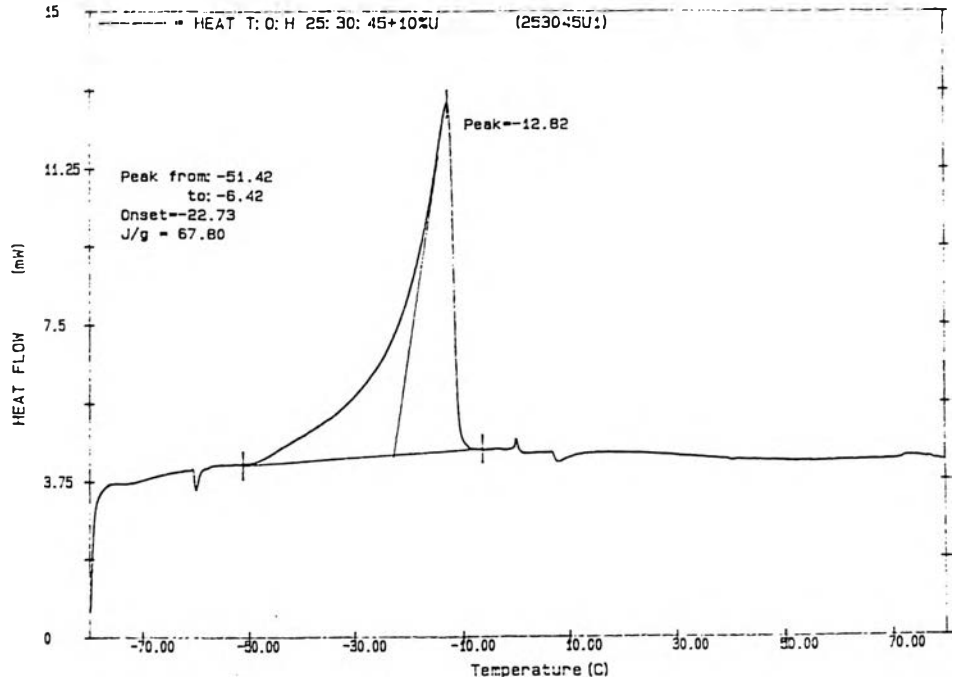


(a)

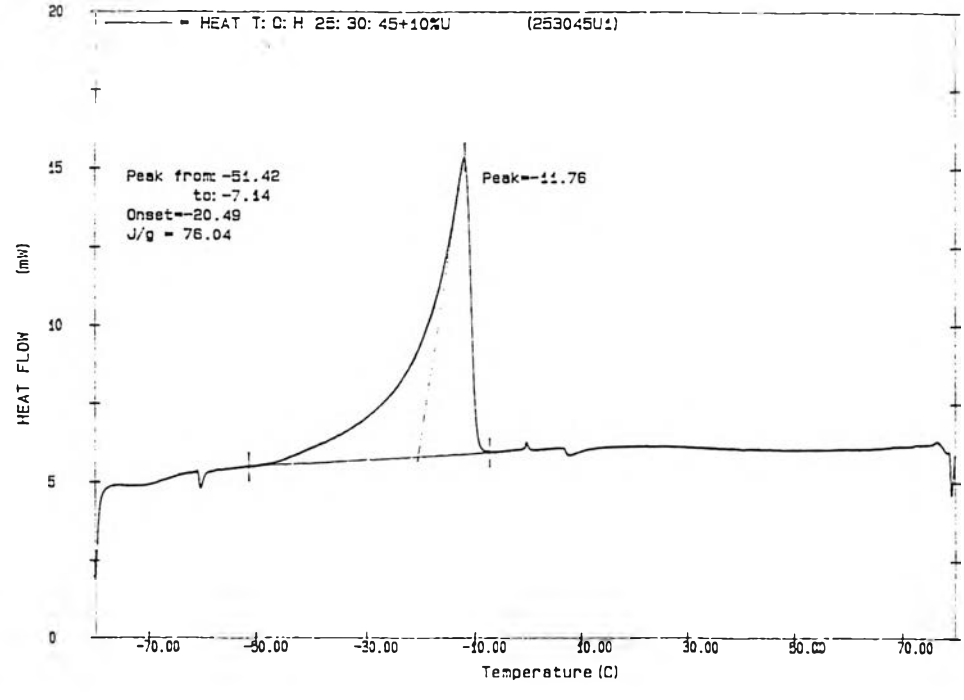


(b)

Figure E.9. DSC Thermograms of the Liquid Crystalline Systems Composed of Triethanolamine:Oleic Acid:Water (15:50:35) With 15% α-Tocopherol (a) at 3 Days (b) at 2 Months.

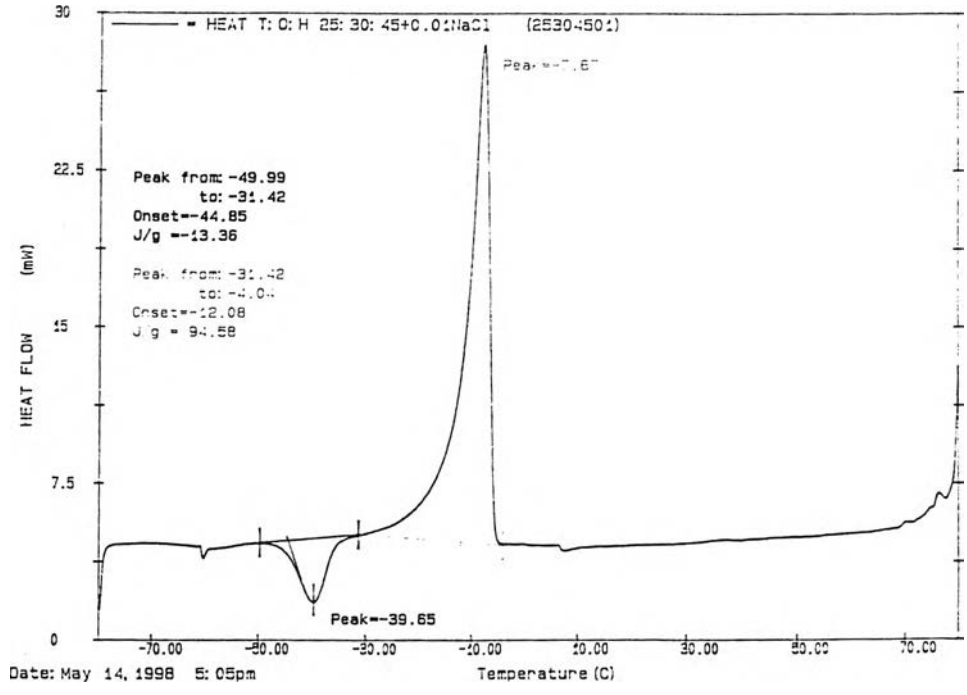


(a)

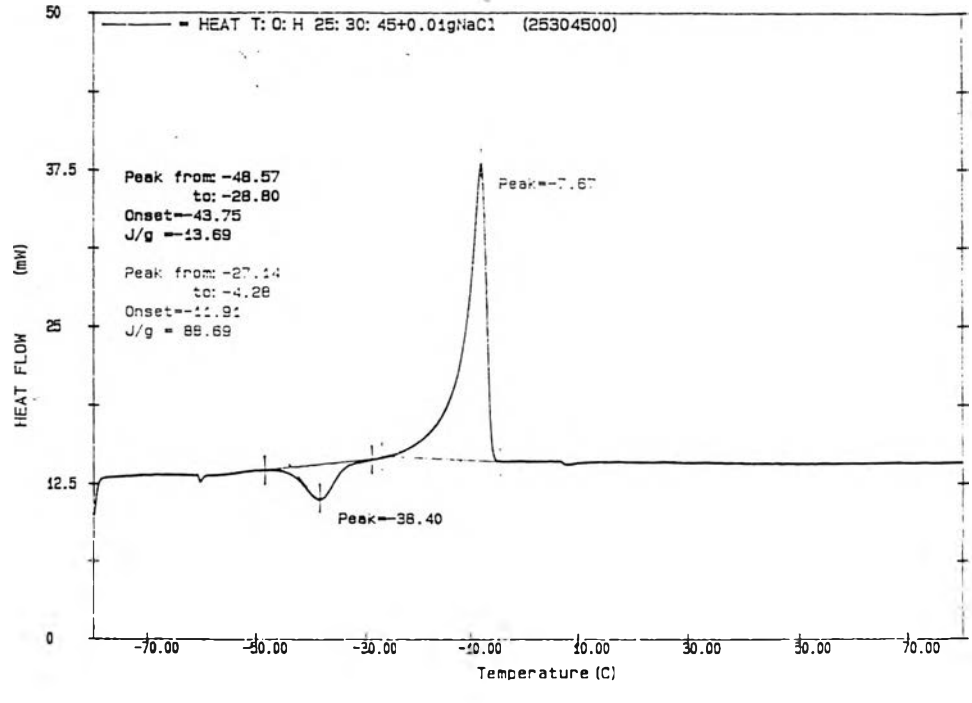


(b)

Figure E.10. DSC Thermograms of the Liquid Crystalline Systems Composed of Triethanolamine:Oleic Acid:Water (25:30:45) With 10% Urea (a) at 3 Days (b) at 2 Months.

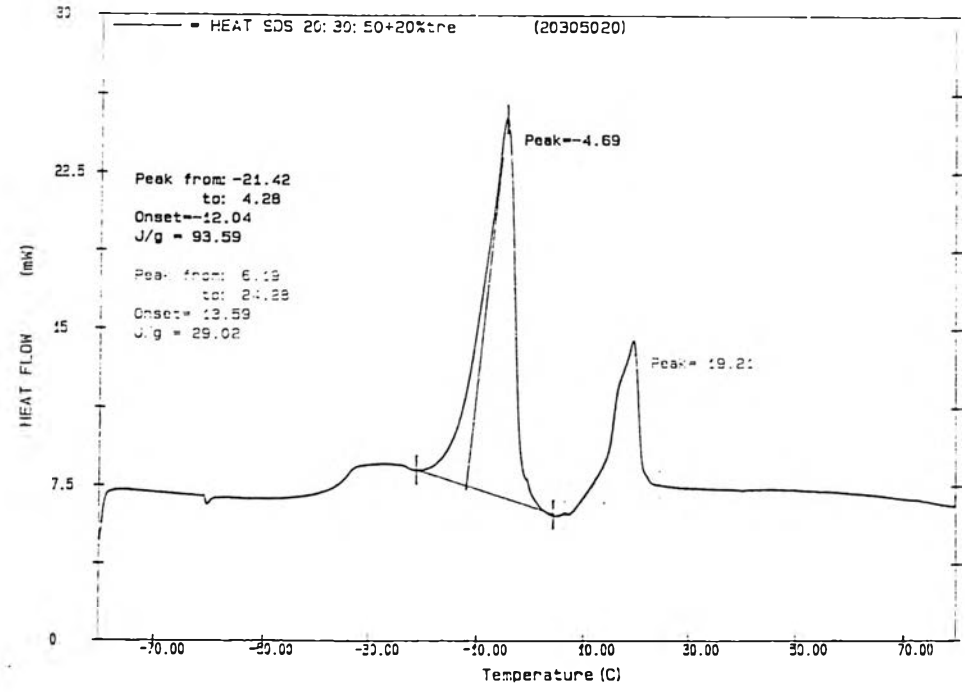


(a)

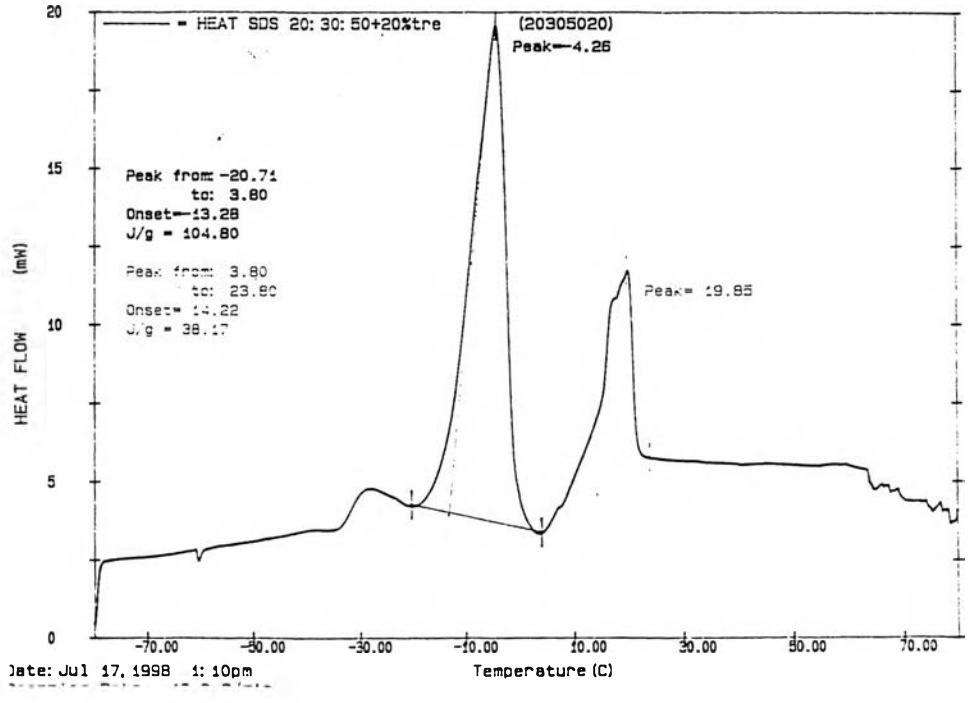


(b)

Figure E.11 DSC Thermograms of the Liquid Crystalline Systems Composed of Triethanolamine:Oleic Acid:Water (25:30:45) With 1% Sodium Chloride (a) at 3 Days (b) at 2 Months.

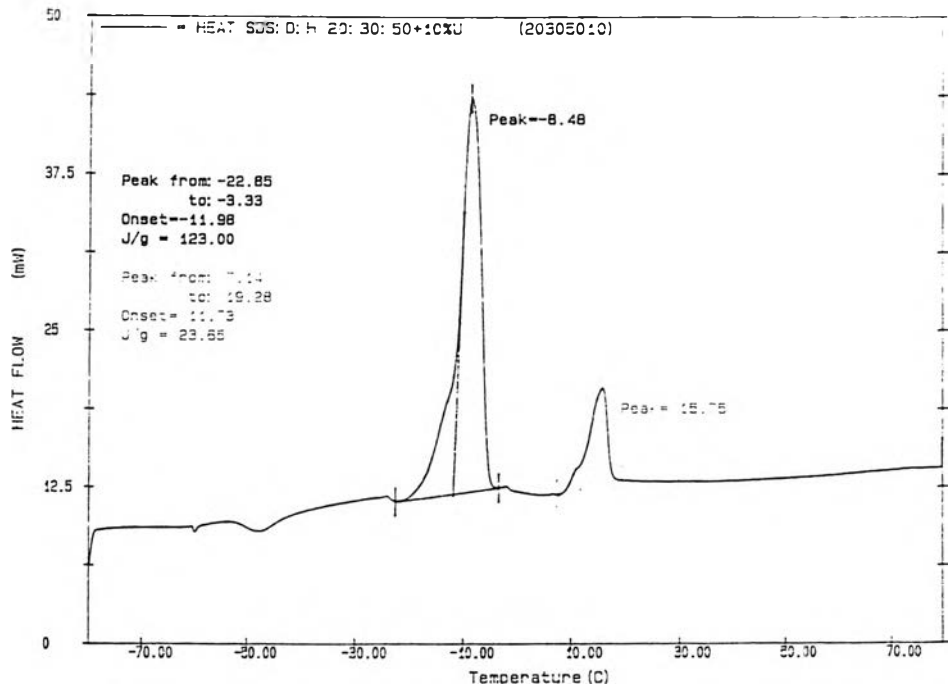


(a)

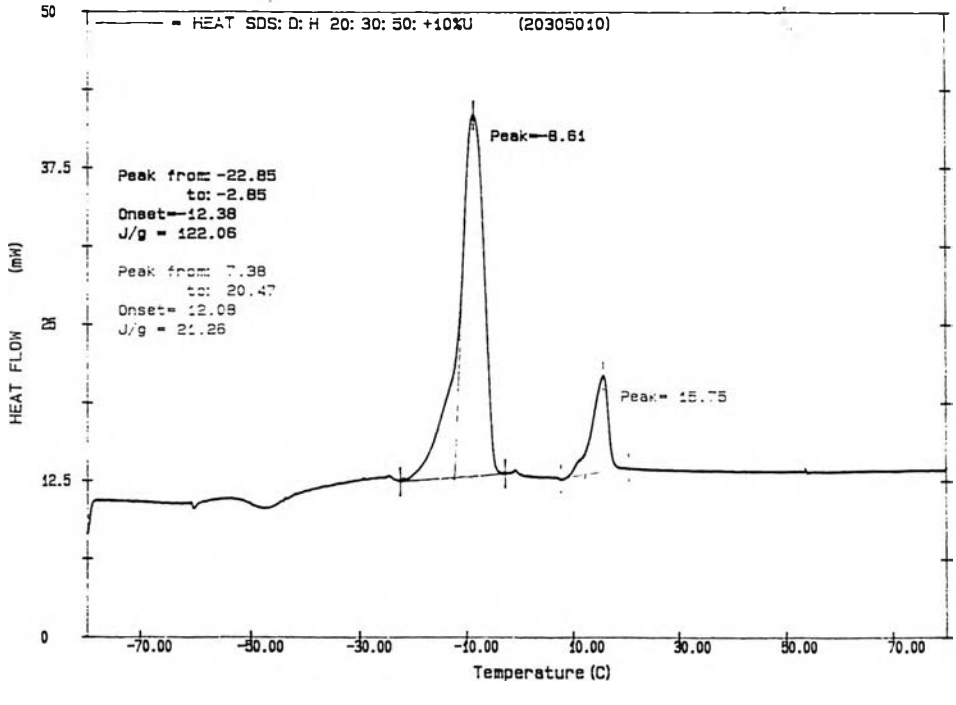


(b)

Figure E.12. DSC Thermograms of the Liquid Crystalline Systems Composed of SDS:Decanol:Water (20:30:50) With 20% Trehalose (a) at 3 Days (b) at 2 Months.

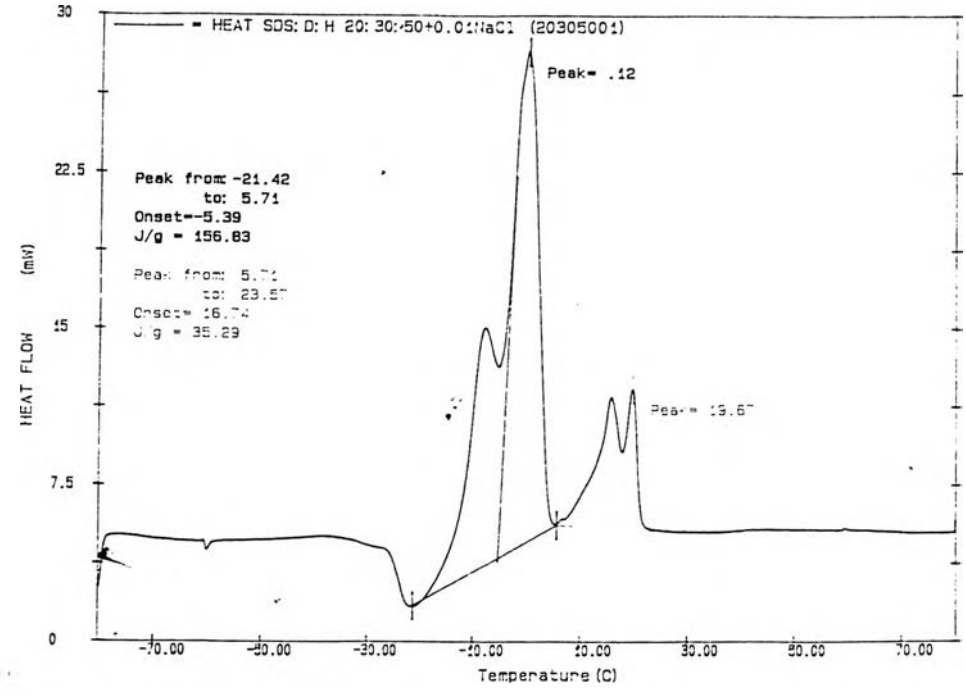


(a)

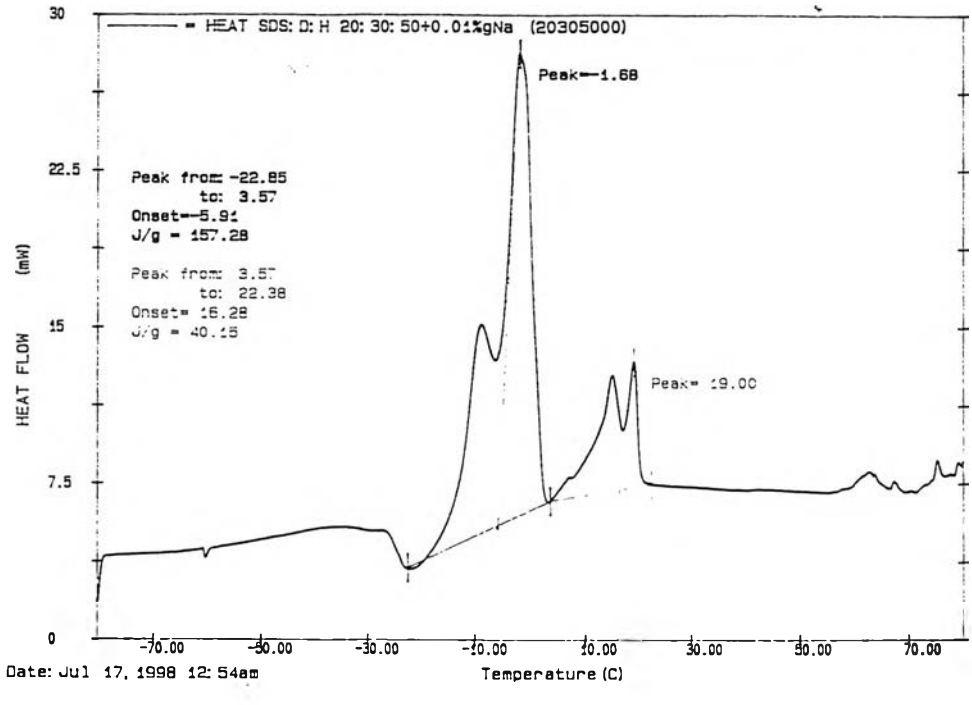


(b)

Figure E.13. DSC Thermograms of the Liquid Crystalline Systems Composed of SDS:Decanol:Water (20:30:50) With 10% Urea (a) at 3 Days (b) at 2 Months.

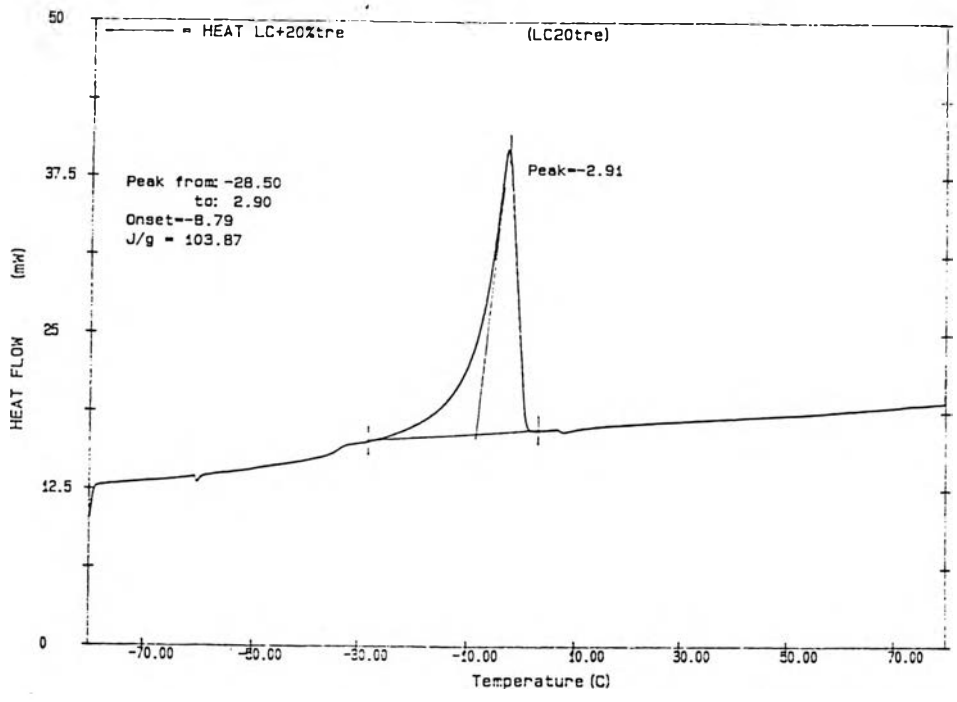


(a)

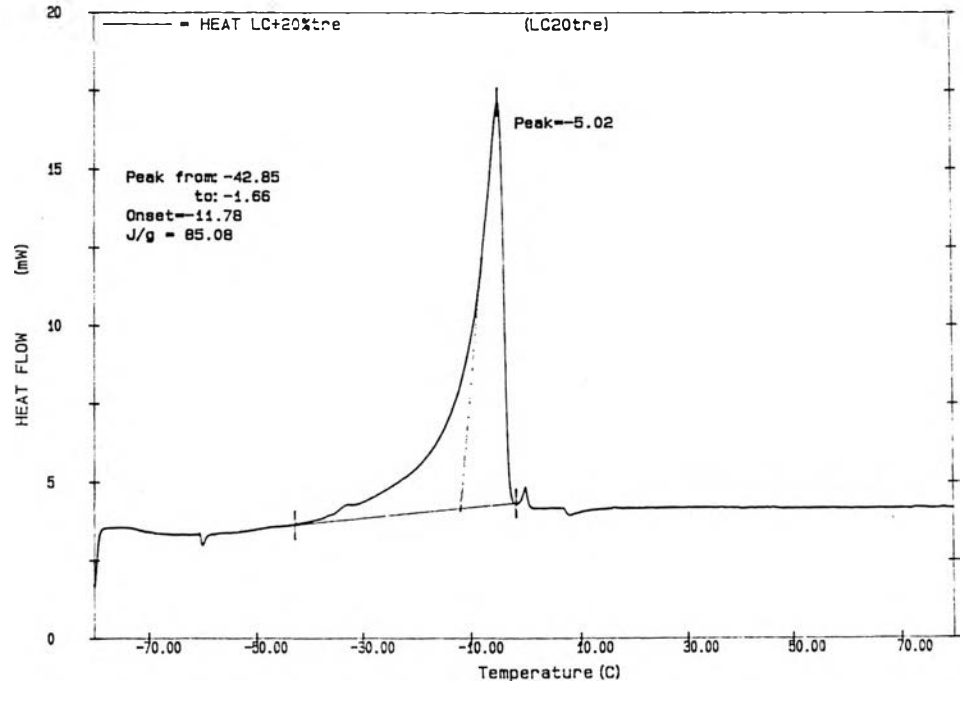


(b)

Figure E.14. DSC Thermograms of the Liquid Crystalline Systems Composed of SDS:Decanol:Water (20:30:50) With 1% Sodium Chloride (a) at 3 Days (b) at 2 Months.

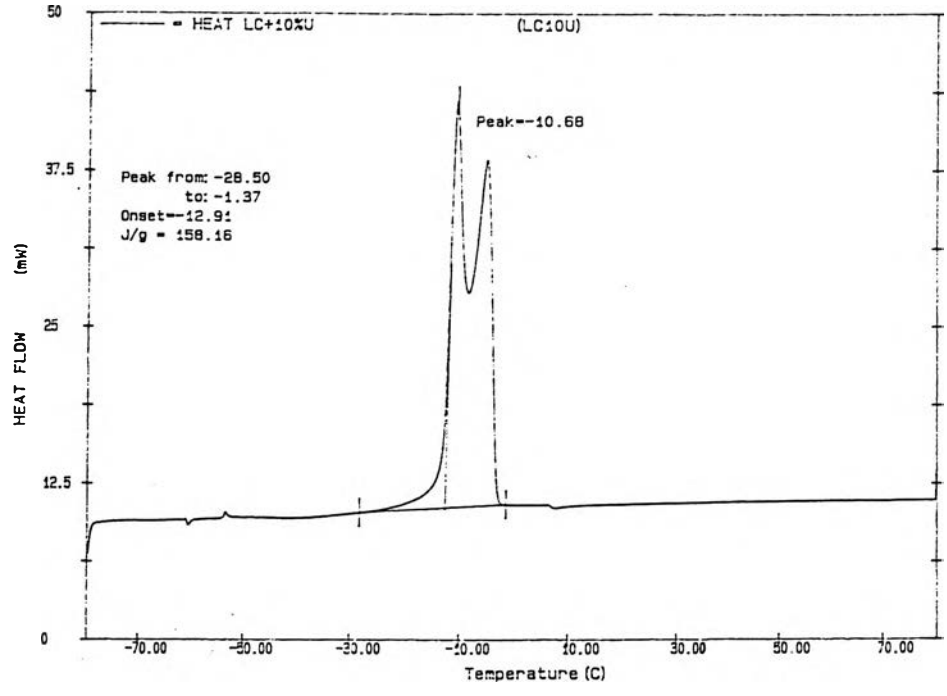


(a)

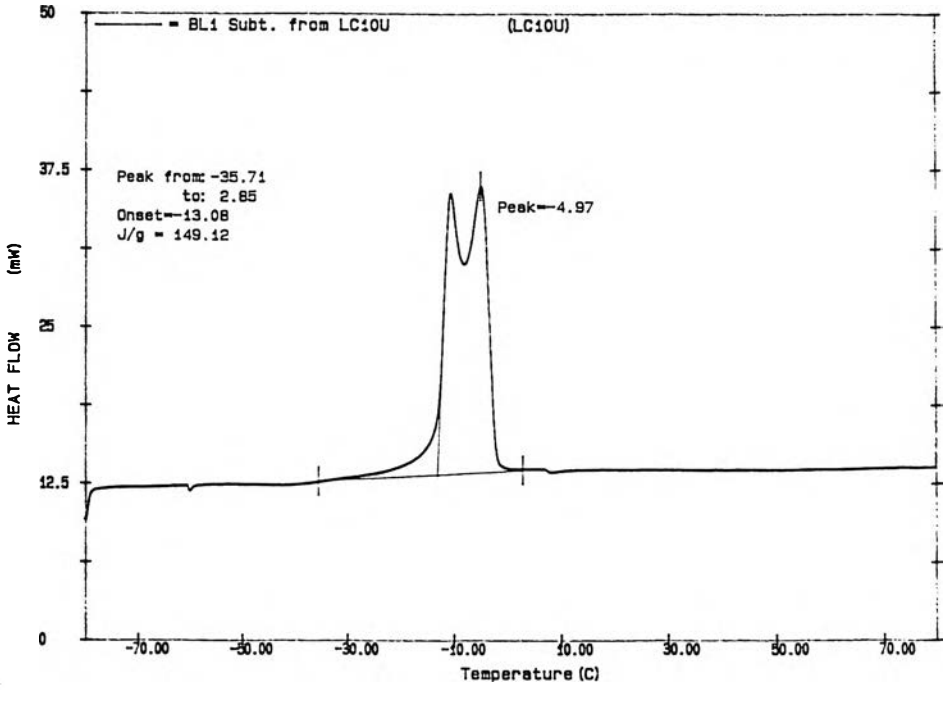


(b)

Figure E.15. DSC Thermograms of the Liquid Crystalline Systems Composed of Lecithin:Water (40:60) With 20% Trehalose (a) at 3 Days (b) at 2 Months.

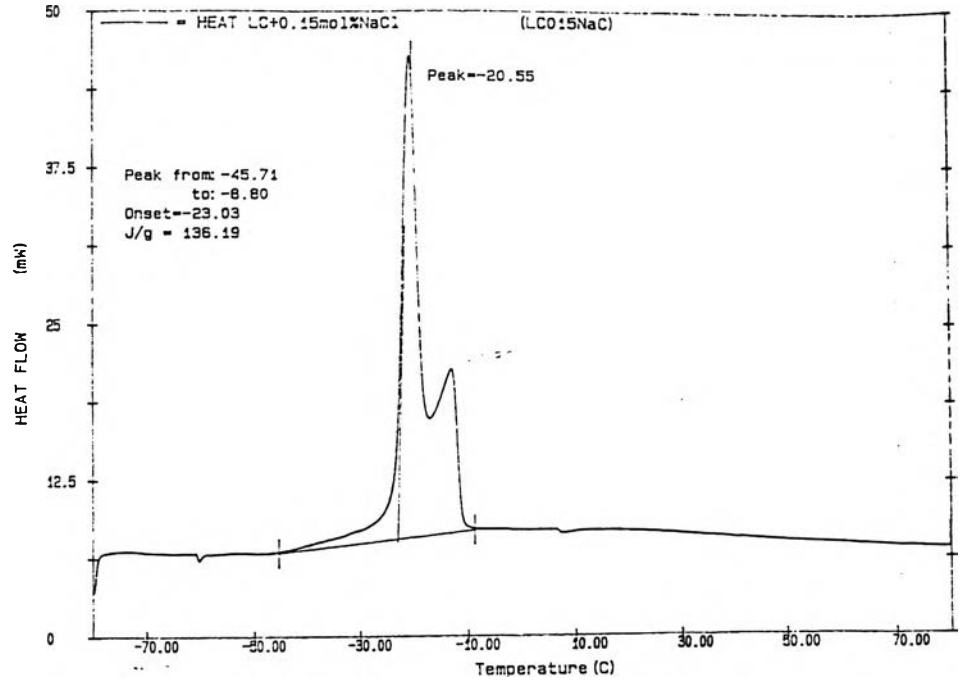


(a)

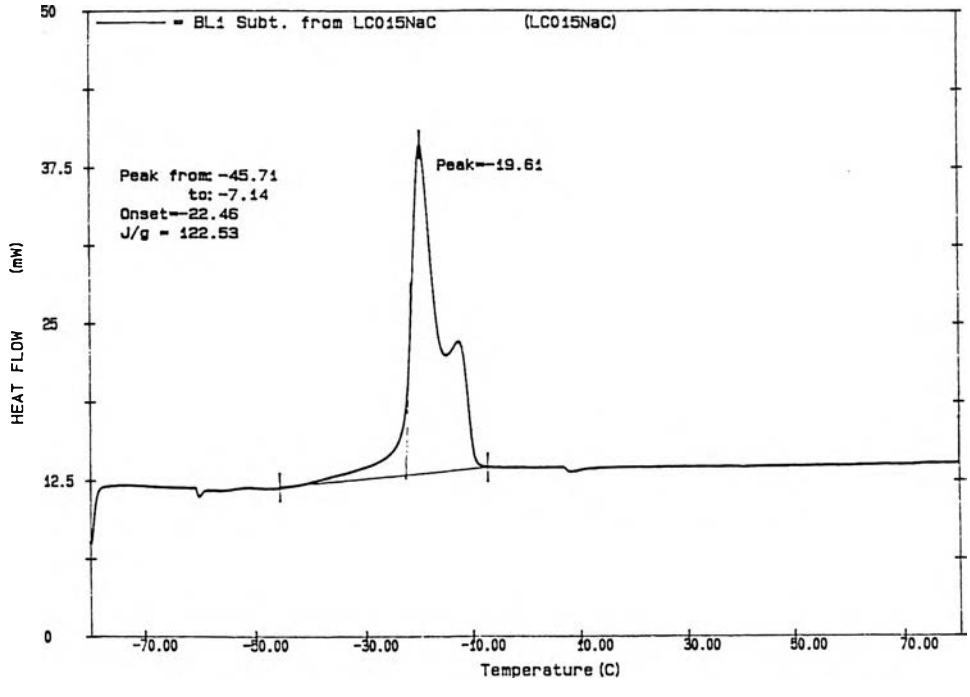


(b)

Figure E.16. DSC Thermograms of the Liquid Crystalline Systems Composed of Lecithin:Water (40:60) With 10% Urea (a) at 3 Days (b) at 2 Months.

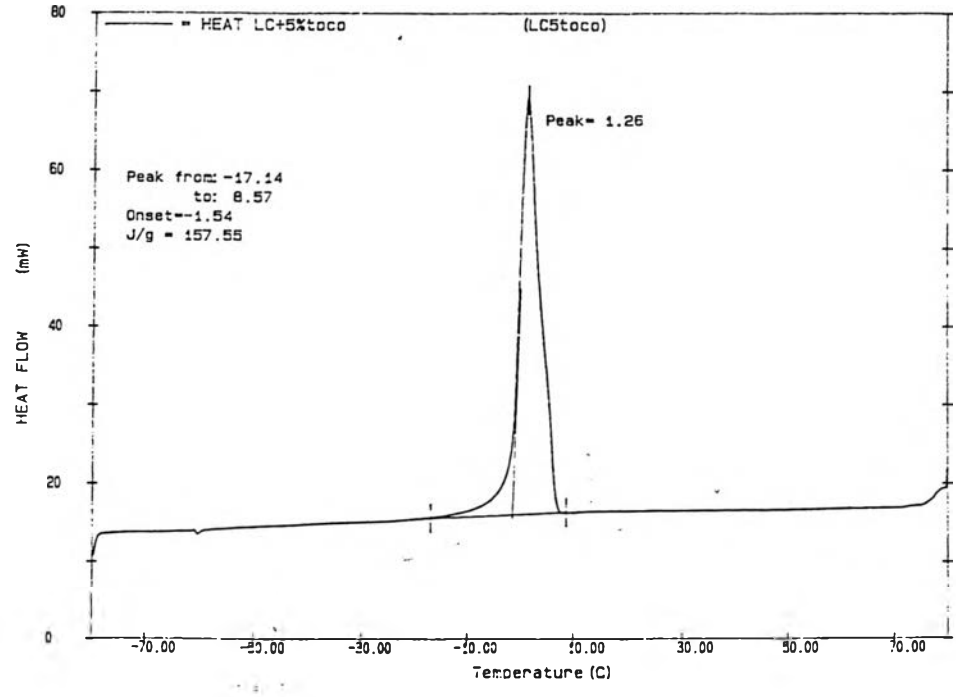


(a)

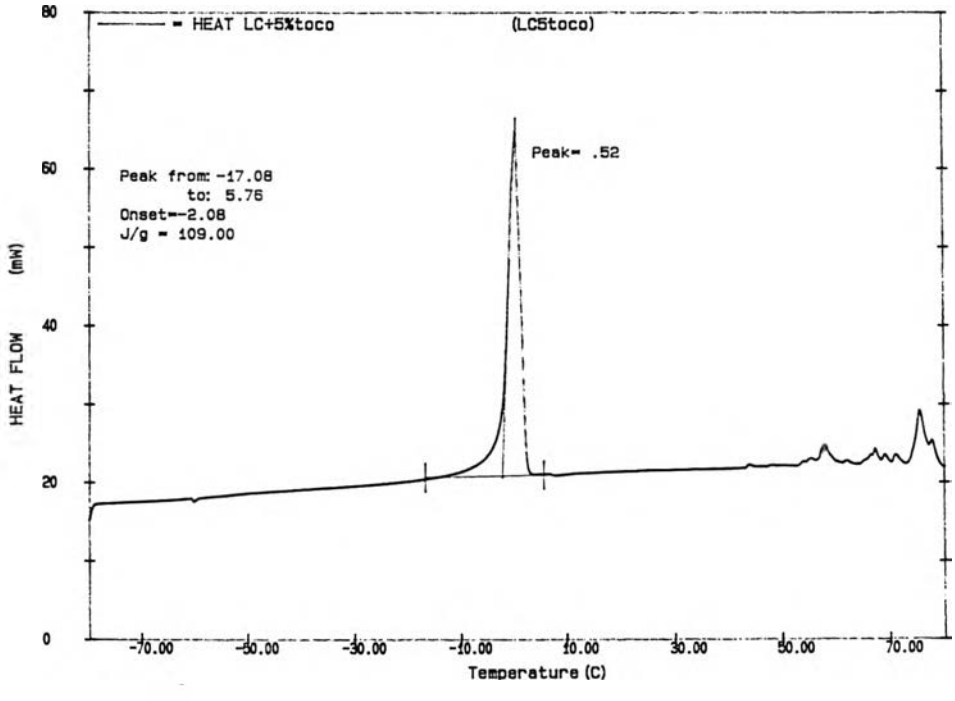


(b)

Figure E.17. DSC Thermograms of the Liquid Crystalline Systems Composed of Lecithin:Water (40:60) With 9% Sodium Chloride (a) at 3 Days (b) at 2 Months.

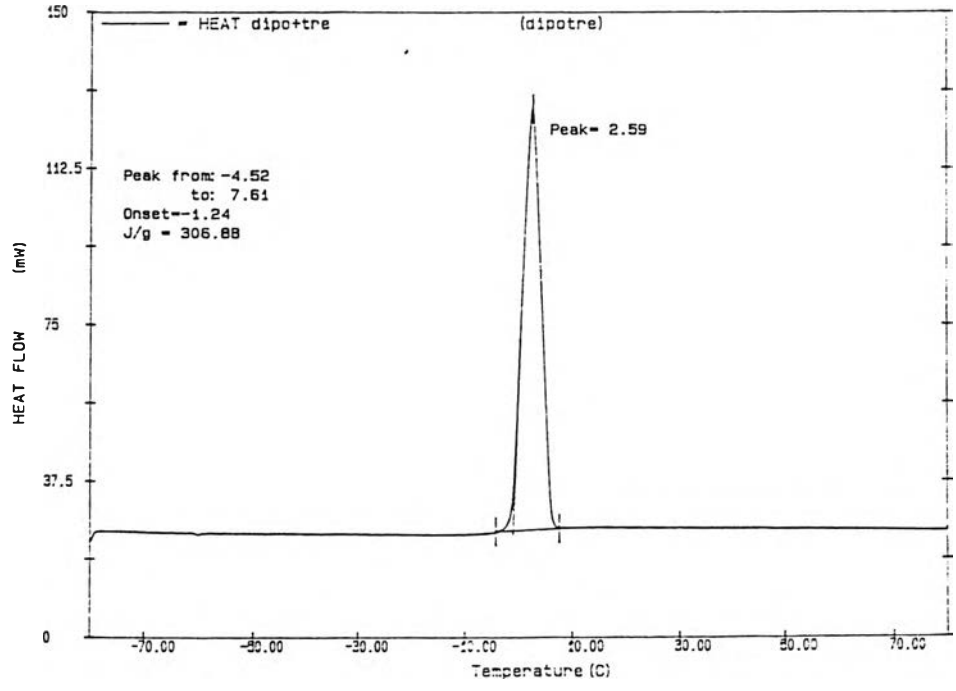


(a)

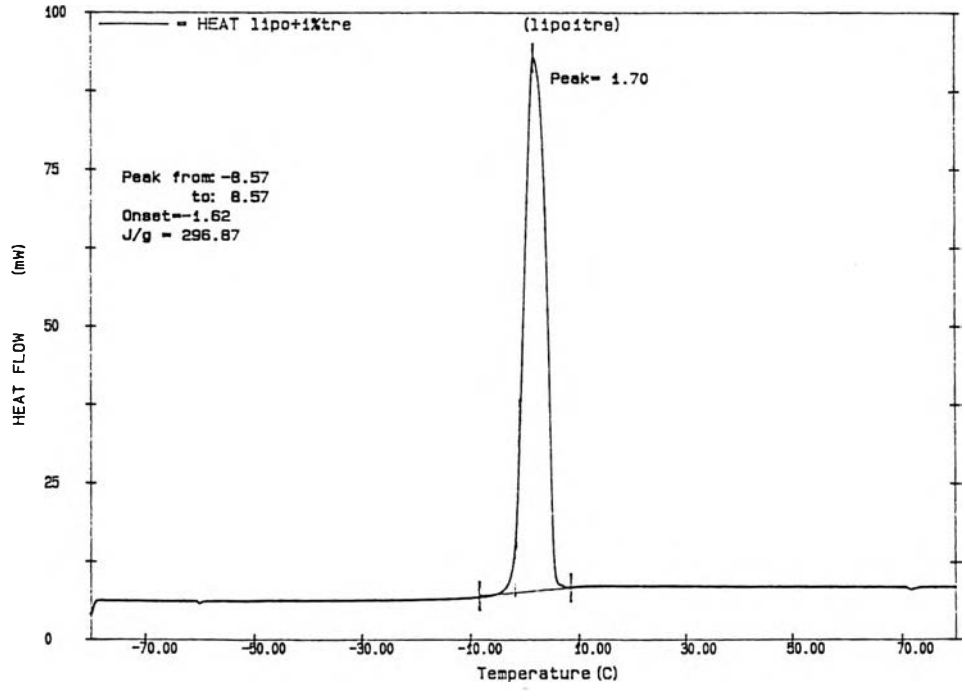


(b)

Figure E.18. DSC Thermograms of the Liquid Crystalline Systems Composed of Lecithin:Water (40:60) With 5% α-Tocopherol (a) at 3 Days (b) at 2 Months.

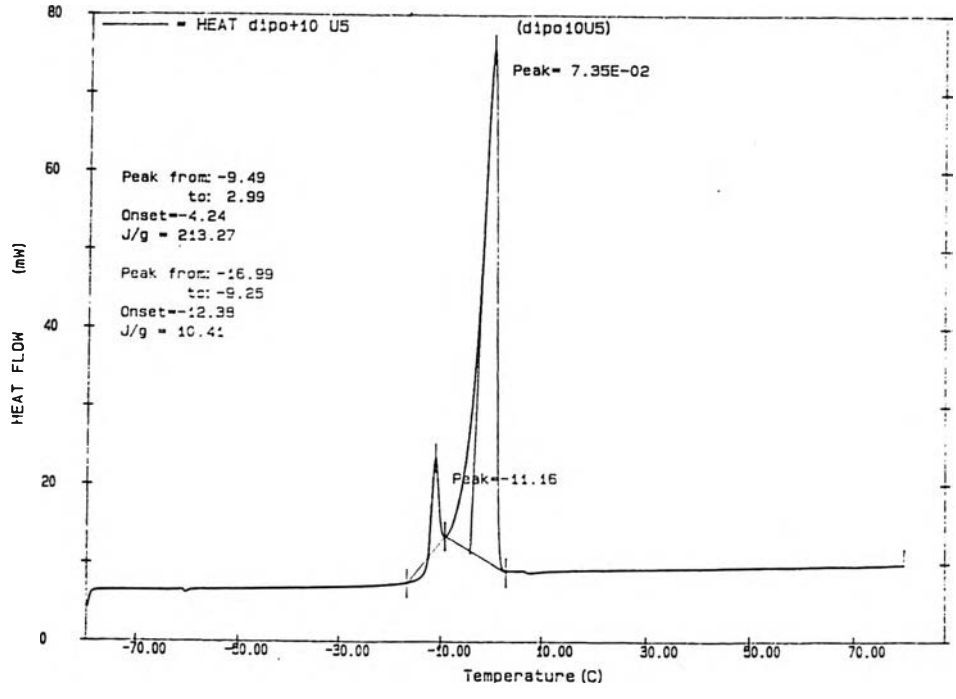


(a)

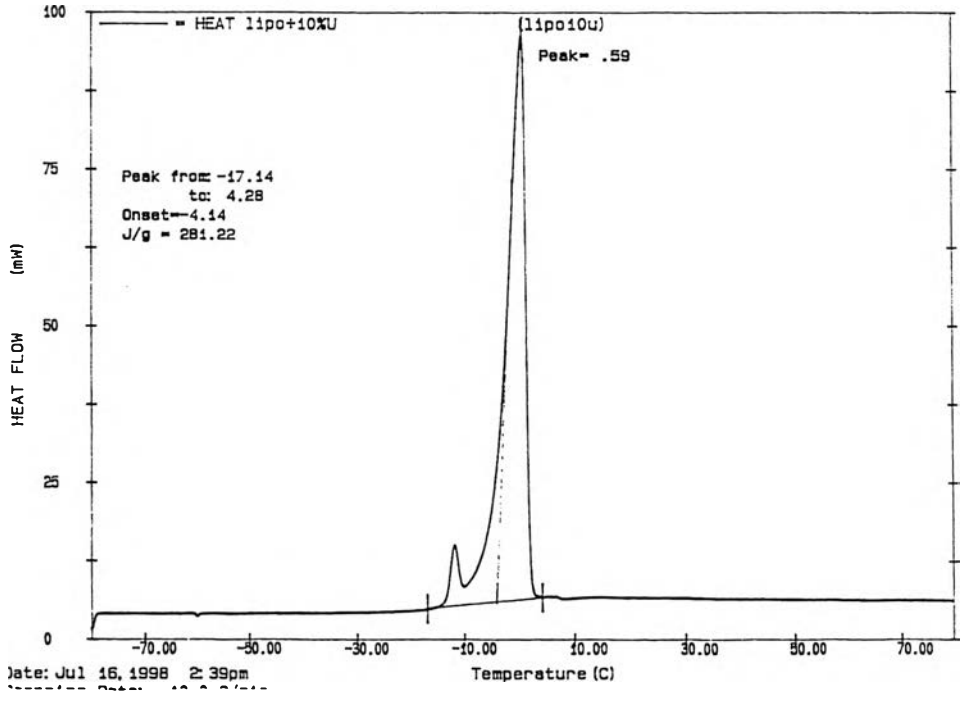


(b)

Figure E.19. DSC Thermograms of the Liposomal System With 1% Trehalose (a) at 3 Days (b) at 2 Months.

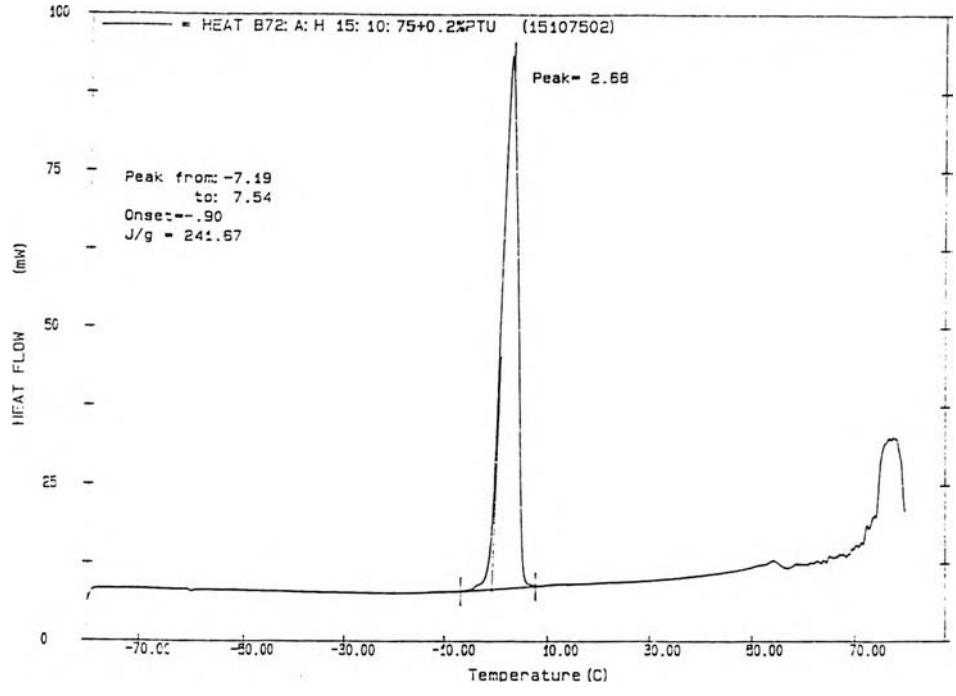


(a)

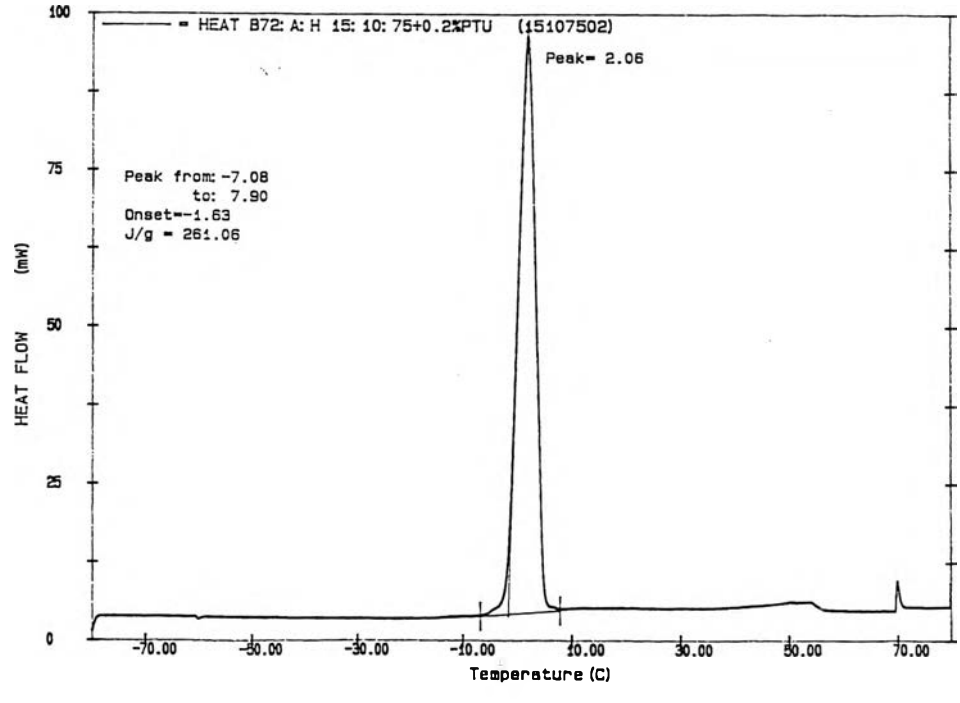


(b)

Figure E.20. DSC Thermograms of the Liposomal System With 10% Urea (a) at 3 Days (b) at 2 Months.

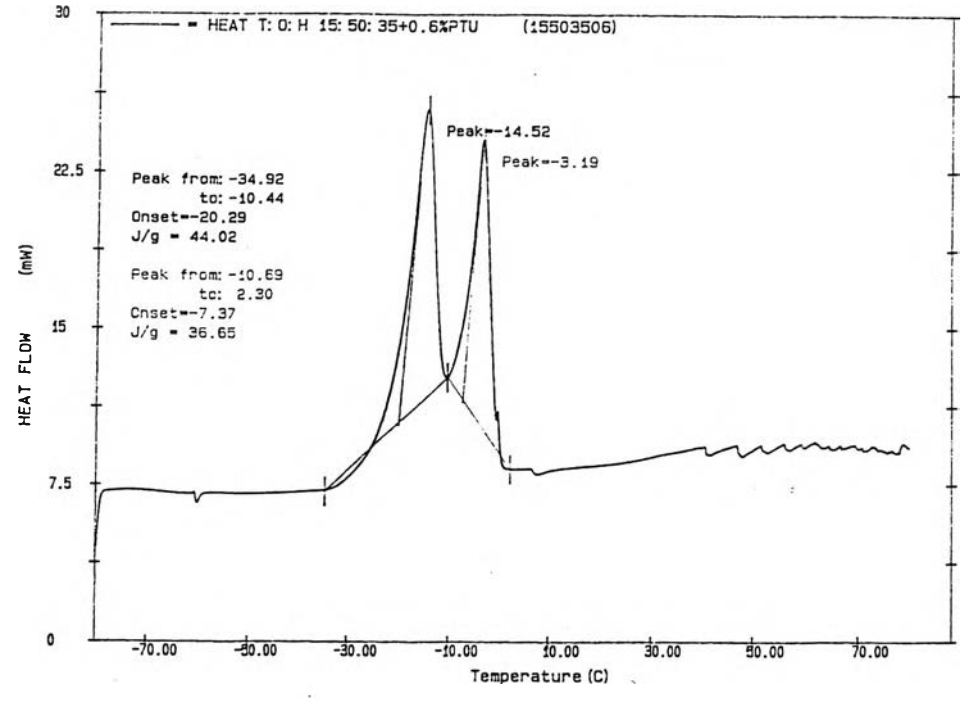


(a)

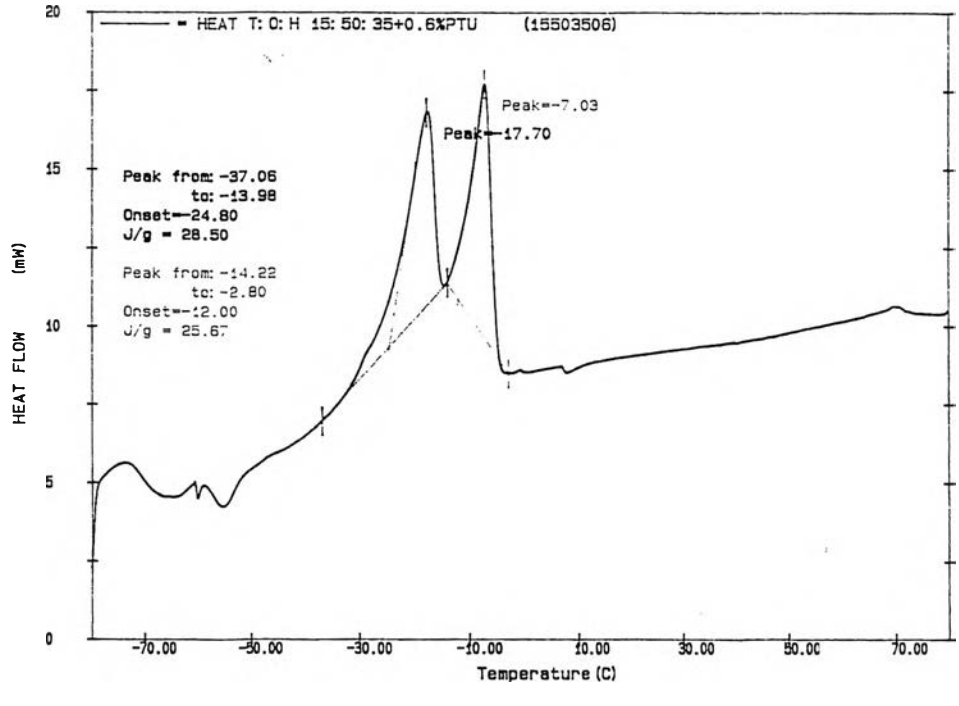


(b)

Figure E.21. DSC Thermograms of the Liquid Crystalline Systems Composed of Brij®72:Arlamol®E:Water (15:10:75) With 0.2% PTU (a) at 3 Days (b) at 2 Months.

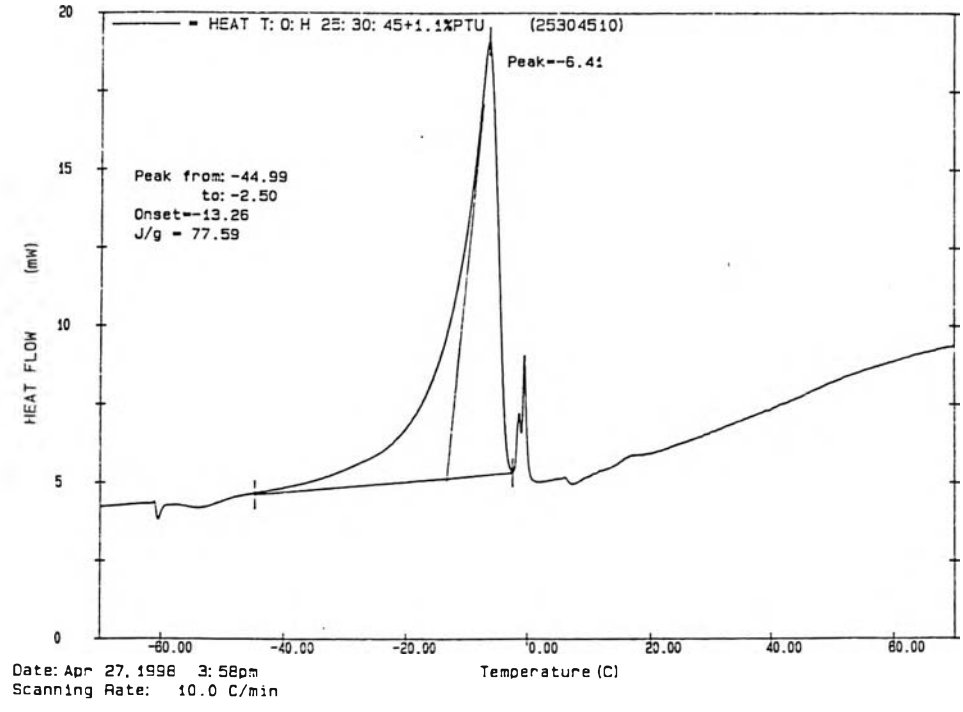


(a)

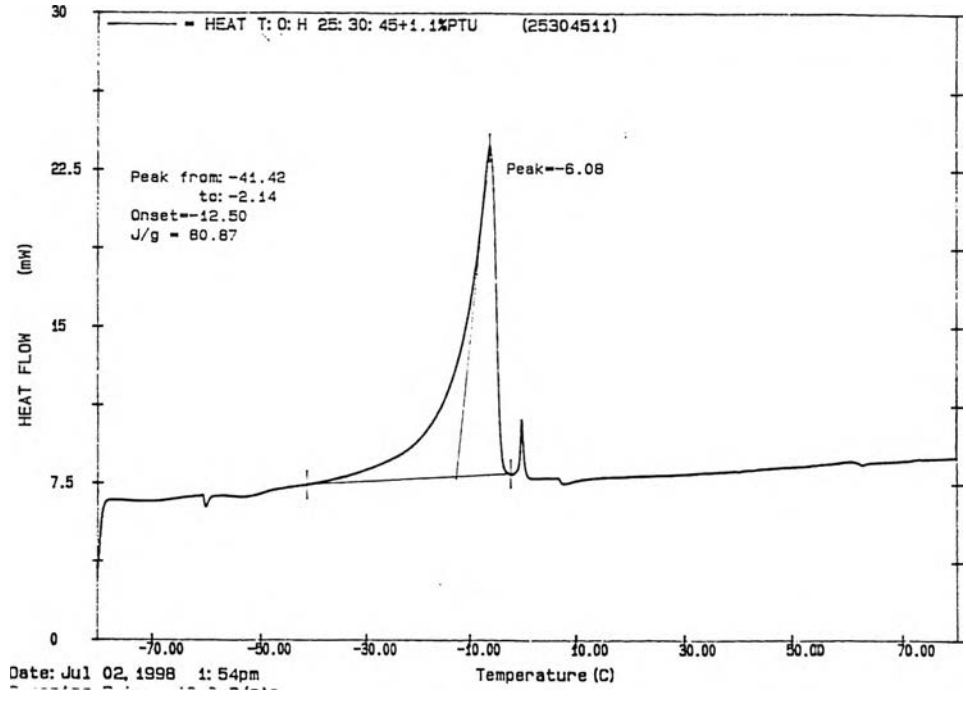


(b)

Figure E.22. DSC Thermograms of the Liquid Crystalline Systems Composed of Triethanolamine:Oleic Acid:Water (15:50:35) With 0.6% PTU (a) at 3 Days (b) at 2 Months.

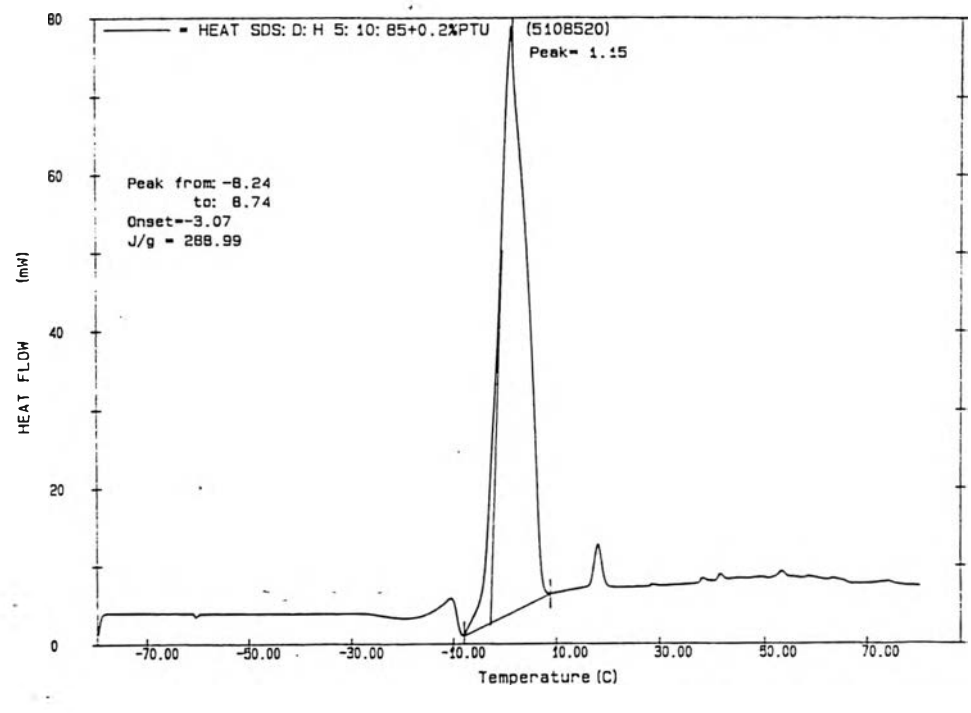


(a)

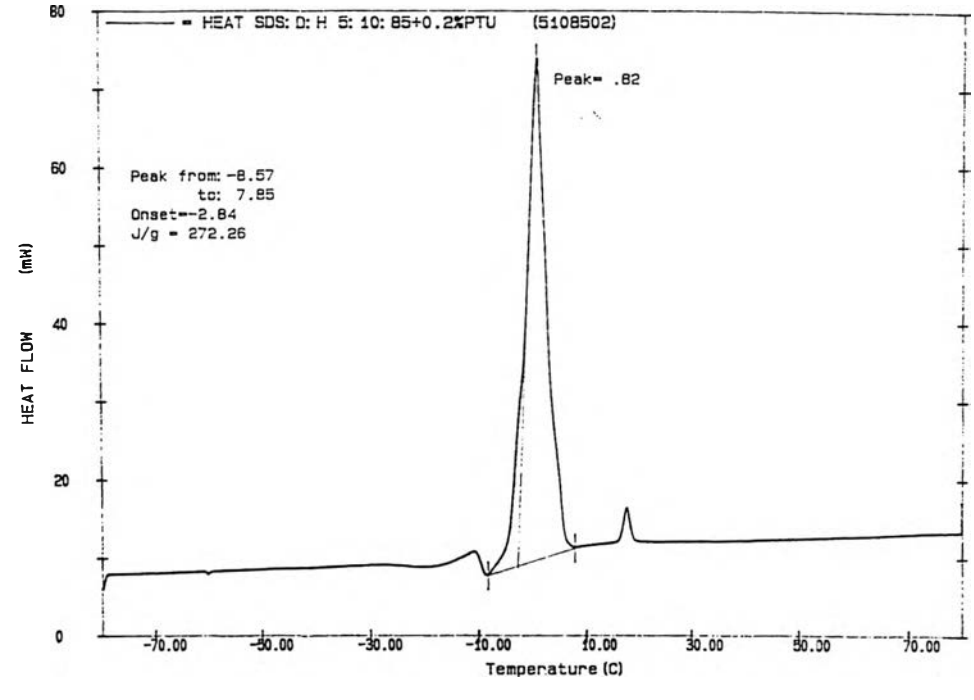


(b)

Figure E.23. DSC Thermograms of the Liquid Crystalline Systems Composed of Triethanolamine:Oleic Acid:Water (25:30:45) With 1.1% PTU (a) at 3 Days (b) at 2 Months.

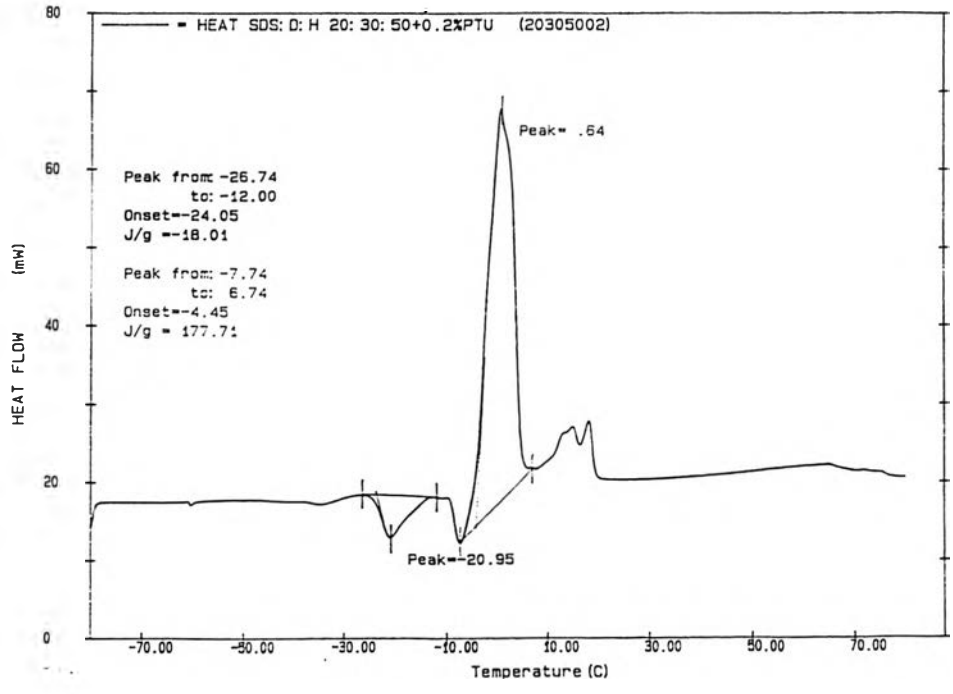


(a)

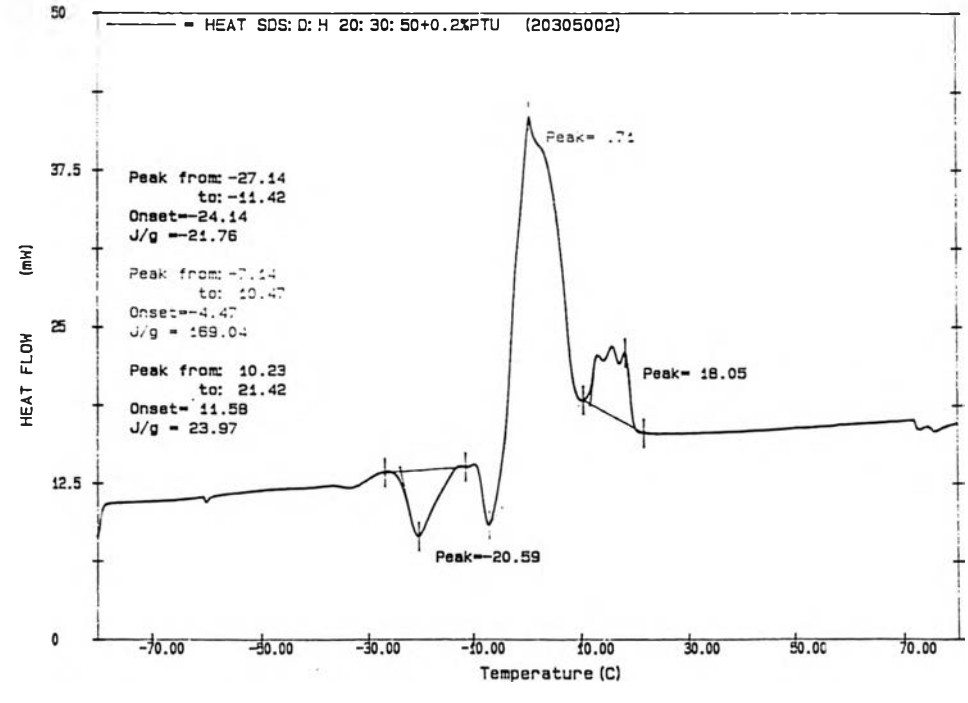


(b)

Figure E.24. DSC Thermograms of the Liquid Crystalline Systems Composed of SDS:Decanol:Water (5:10:85) With 0.2% PTU (a) at 3 Days (b) at 2 Months.

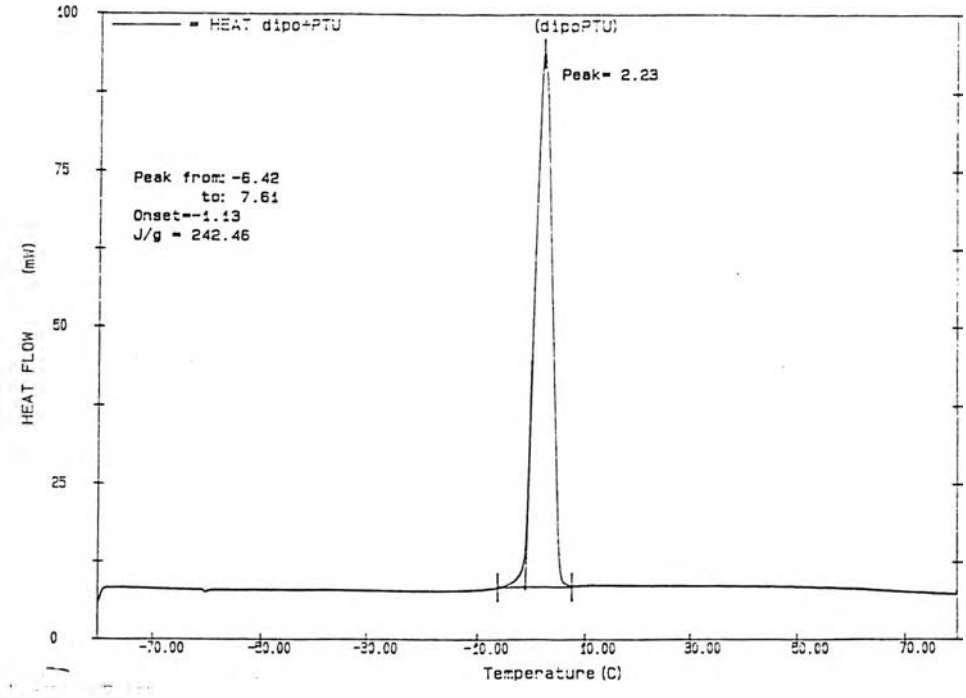


(a)

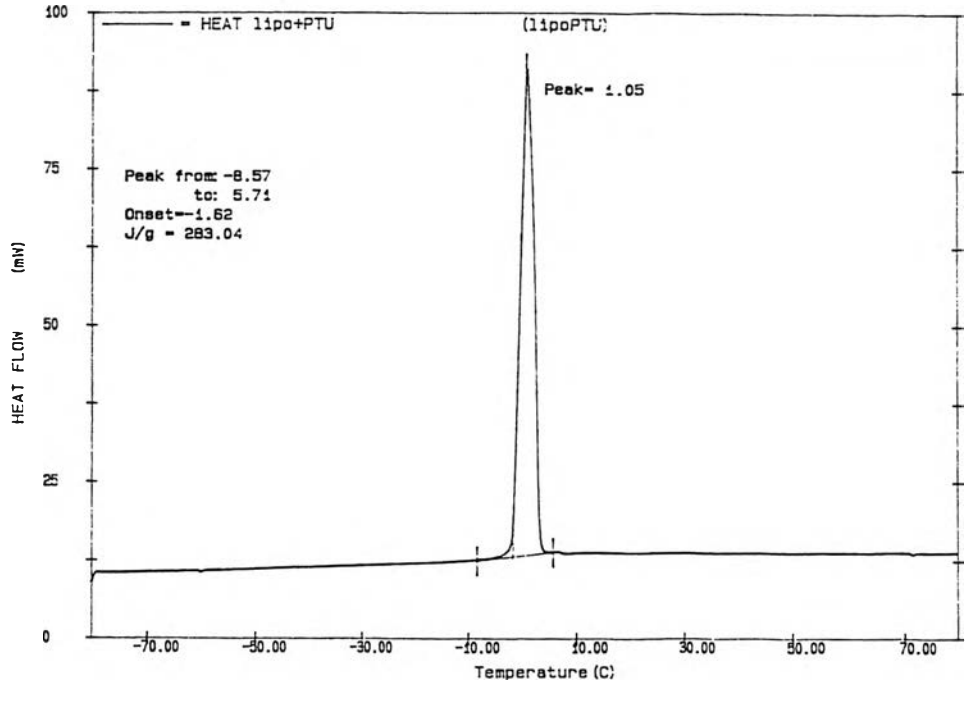


(b)

Figure E.25. DSC Thermograms of the Liquid Crystalline Systems Composed of SDS:Decanol:Water (20:30:50) With 0.2% PTU (a) at 3 Days (b) at 2 Months.

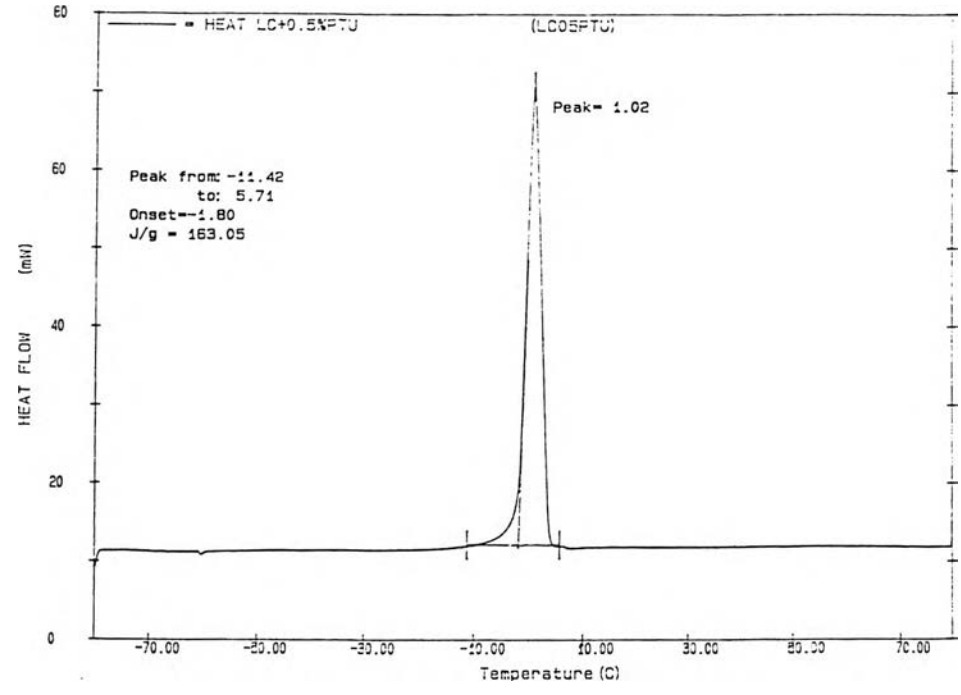


(a)

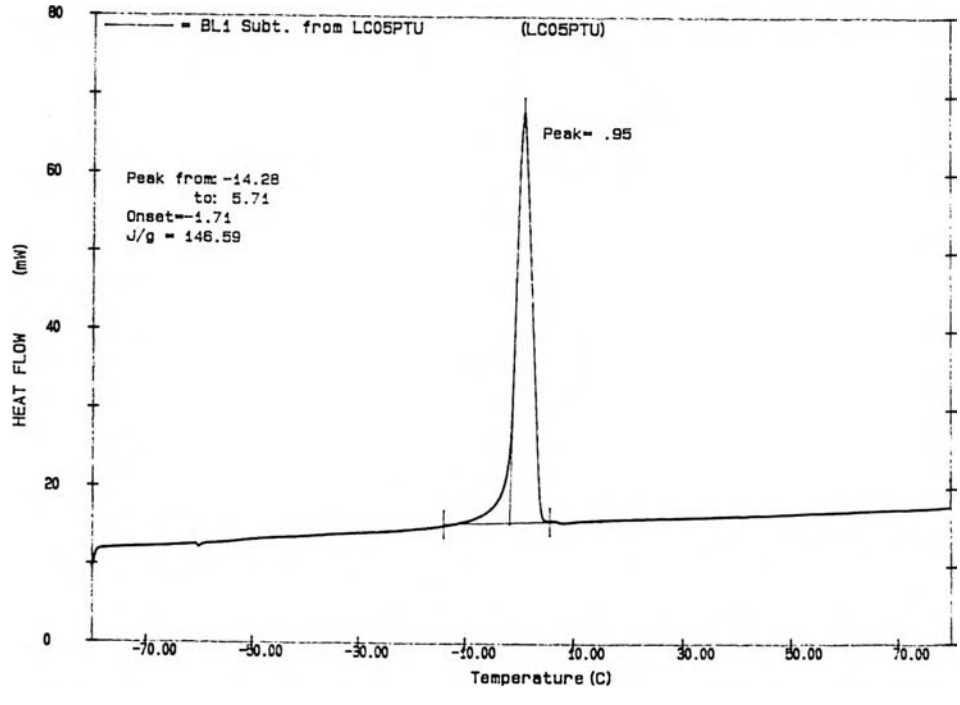


(b)

Figure E.26. DSC Thermograms of the Liposomal Systems With PTU (a) at 3 Days (b) at 2 Months.



(a)



(b)

Figure E.27. DSC Thermograms of the Liquid Crystalline Systems Composed of Lecithin:Water (40:60) With 0.5% PTU (a) at 3 Days (b) at 2 Months.

APPENDIX F

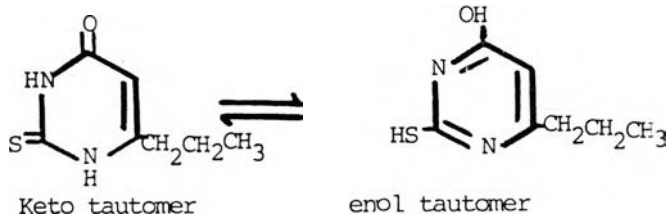
1. Molecular Structure and Physical Properties of Propylthiouracil (PTU)

(from Aboul-Enein, 1977)

1.1 Molecular Structure

1.1.1 Empirical : $C_7H_{10}N_2OS$

1.1.2 Structural :



Keto tautomer enol tautomer

1.2.3 Molecular Weight : 170.23

1.2 Physical Properties

1.2.1 Melting Range

USP XIV specifies a melting range for propylthiouracil between 219-221°C.

1.2.2 Solubility

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.

1.2.3 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 3 maxima at 315.5 nm (a_m 10900), 260 nm (a_m 10700), and at 207.5 nm (a_m 15400).

1.2.4 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.

2. The Saturation Solubility of PTU in Distilled Water at Room Temperature

The aqueous solubility of PTU was experimentally determined since the quality of water and temperature can affect the solubility. The saturation solubility of PTU in distilled water was determined by continuous shaking of excess amounts of PTU in water at room temperature. The sample was removed at appropriate time intervals and was centrifuged for10 minutes at high speed to separate drug crystals. Supernatant was appropriately diluted and analyzed by UV spectrophotometry.

The results of the solubility study are as follows:

Time	Absorbance			Amount of PTU (μg/ml)			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3		
4	0.609	0.587	0.573	1532.50	1475.00	1440.00	1482.50	38.13
8	0.598	0.622	0.589	1505.00	1565.00	1480.00	1516.67	35.67
12	0.619	0.674	0.597	1557.50	1697.50	1502.50	1585.83	82.09
16	0.627	0.641	0.584	1577.50	1612.50	1467.50	1552.50	61.78
20	0.618	0.640	0.591	1555.00	1610.00	1485.00	1550.00	51.15
24	0.630	0.638	0.595	1585.00	1605.00	1497.50	1562.50	46.68

Calibration Data for Assay of Saturation Solubility of PTU in Distilled Water

Concentration (mcg/mL)	0.72	1.44	2.88	4.32	5.76	7.2	8.64
Absorbance	0.074	0.147	0.290	0.429	0.572	0.719	0.854

$y = 0.0987x - 0.0043$; $R^2 = 0.9999$

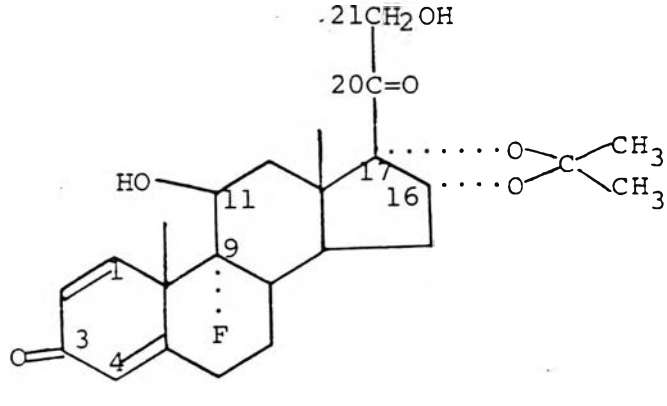
3. Molecular Structure and Physical Properties of Triamcinolone Acetonide (TA)

(from Florey, 1972)

3.1 Molecular Structure

3.1.1 Empirical : $C_{24}H_{31}FO_6$

3.1.2 Structural :



3.1.3 Molecular Weight : 434.49

3.2 Physical Properties

3.2.1 Melting Range

Like many steroids, TA does not exhibit a sharp melting point. The melting temperature range is wide and depends on the rate of heating.

The following melting point temperatures (°C) have been reported: 292-294, 274-278, 277-281, 276-278.

3.2.2 Solubility

The following solubility data were obtained at room temperature:

50 mg/ml in 95% ethanol

40 mg/ml in isopropyl alcohol

90 mg/ml in acetone

25 mg/ml in chloroform

250 mg/ml in dimethylformamide.

The solubilities in water as well as isotonic saline (pH 7) at 23°C and 37°C were determined as 0.004±0.002% (40 μg/ml)

3.2.3 Ultraviolet Spectrum

Bernstein reported the maximal wavelength at 238-239 nm (a_m 14,600) in ethanol.

3.2.4 Stability

TA is very stable as a solid. In aqueous and alcohol solutions, it is prone to oxidative rearrangement and degradation at alkaline pH's.

APPENDIX G

Water Evaporation from Liquid Crystalline Systems, Non-ionic Cream Base and Bulk Water on Controlled Temperature Warm Plate at 32^0C in Ambient Atmosphere

(Relative Humidity = 45-60%, Temperature = 28-29 ^{0}C)

Table G.1. Water Evaporation from Liquid Crystalline System Composed of Brij®72:Arlamol®E:Water (15:10:75)

Time (min)	Weight Loss (mg)			Cumulative Weight Loss (mg)			% Cumulative Weight Loss			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
5	4.00	8.00	1.40	4.00	8.00	1.40	0.78	1.55	0.27	0.87	0.65
10	4.20	2.70	2.60	8.20	10.70	4.00	1.59	2.08	0.78	1.48	0.66
15	4.80	2.50	1.90	13.00	13.20	5.90	2.52	2.56	1.15	2.08	0.81
20	4.10	2.50	1.90	17.10	15.70	7.80	3.32	3.05	1.51	2.63	0.97
25	4.10	2.50	1.50	21.20	18.20	9.30	4.12	3.53	1.81	3.15	1.20
30	4.10	1.70	1.40	25.30	19.90	10.70	4.91	3.86	2.08	3.62	1.43
35	3.60	1.40	1.40	28.90	21.30	12.10	5.61	4.14	2.35	4.03	1.63
40	3.60	1.40	1.10	32.50	22.70	13.20	6.31	4.41	2.56	4.43	1.87
45	3.30	1.20	1.00	35.80	23.90	14.20	6.95	4.64	2.76	4.78	2.10
50	3.30	1.10	0.90	39.10	25.00	15.10	7.59	4.86	2.93	5.13	2.34
55	3.30	1.50	1.10	42.40	26.50	16.20	8.23	5.15	3.15	5.51	2.56
60	3.10	1.00	0.80	45.50	27.50	17.00	8.84	5.34	3.30	5.83	2.80
65	2.60	1.00	0.80	48.10	28.50	17.80	9.34	5.54	3.46	6.11	2.98
70	2.90	0.90	1.00	51.00	29.40	18.80	9.90	5.71	3.65	6.42	3.19
75	3.10	0.60	0.60	54.10	30.00	19.40	10.51	5.83	3.77	6.70	3.45
80	2.50	1.30	0.90	56.60	31.30	20.30	10.99	6.08	3.94	7.00	3.61
85	2.50	0.80	0.60	59.10	32.10	20.90	11.48	6.23	4.06	7.26	3.81
90	2.30	1.00	0.70	61.40	33.10	21.60	11.92	6.43	4.19	7.52	3.98

Table G.2. Water Evaporation from Liquid Crystalline System Composed of Triethanolamine:Oleic acid:Water (25:30:45)

Time (min)	Weight Loss (mg)			Cumulative Weight Loss (mg)			% Cumulative Weight Loss			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
5	7.00	8.60	3.60	7.00	8.60	3.60	2.09	2.57	1.07	1.91	0.77
10	6.70	7.70	6.00	13.70	16.30	9.60	4.09	2.48	2.87	3.15	0.84
15	7.10	7.70	6.00	20.80	24.00	15.60	6.21	7.16	4.66	6.01	1.26
20	6.80	6.70	5.90	27.60	30.70	21.50	8.24	9.16	6.42	7.94	1.39
25	6.40	7.20	5.70	34.00	37.90	27.20	10.15	11.31	8.12	9.86	1.61
30	6.40	6.40	5.10	40.40	44.30	32.30	12.06	13.22	9.64	11.64	1.83
35	5.70	6.50	5.50	46.10	50.80	37.80	13.76	15.16	11.28	13.40	1.96
40	5.50	5.90	5.00	51.60	56.70	42.80	15.40	16.93	12.78	15.04	2.10
45	5.10	5.80	4.90	56.70	62.50	47.70	16.93	18.66	14.24	16.61	2.23
50	5.30	5.70	4.90	62.00	68.20	52.60	18.51	20.36	15.70	18.19	2.35
55	4.80	5.10	4.50	66.80	73.30	57.10	19.94	21.88	17.04	19.62	2.44
60	5.00	4.80	4.60	71.80	78.10	61.70	21.43	23.31	18.42	21.05	2.47
65	4.30	5.20	4.50	76.10	83.30	66.20	22.72	24.87	19.76	22.45	2.57
70	4.70	4.70	4.50	80.80	88.00	70.70	24.12	26.27	21.10	23.83	2.60
75	4.10	4.20	4.20	84.90	92.20	74.90	25.34	27.52	22.36	25.07	2.59
80	3.80	4.10	4.30	88.70	96.30	79.20	26.48	28.75	23.64	26.29	2.56
85	4.10	4.20	4.10	92.80	100.50	83.30	27.70	30.00	24.87	27.52	2.57
90	3.90	4.10	4.00	96.70	104.60	87.30	28.87	31.22	26.06	28.72	2.58

Table G.3. Water Evaporation from Liquid Crystalline System Composed of Triethanolamine:Oleic acid:Water (10:50:40)

Time (min)	Weight Loss (mg)			Cumulative Weight Loss (mg)			% Cumulative Weight Loss			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
5	4.50	2.30	3.30	4.50	2.30	3.30	1.54	0.79	1.13	1.15	0.38
10	3.90	5.50	2.70	8.40	7.80	6.00	2.87	2.66	2.05	2.53	0.43
15	3.50	3.30	2.60	11.90	11.10	8.60	4.06	3.79	2.94	3.60	0.59
20	3.10	2.70	2.40	15.00	13.80	11.00	5.12	4.71	3.76	4.53	0.70
25	2.60	3.00	2.10	17.60	16.80	13.10	6.01	5.74	4.47	5.41	0.82
30	2.60	2.30	1.40	20.20	19.10	14.50	6.90	6.52	4.95	6.12	1.03
35	2.10	2.40	1.70	22.30	21.50	16.20	7.61	7.34	5.53	6.83	1.13
40	1.90	2.20	1.60	24.20	23.70	17.80	8.26	8.09	6.08	7.48	1.22
45	2.40	2.00	1.30	26.60	25.70	19.10	9.08	8.77	6.52	8.13	1.40
50	1.80	1.40	1.00	28.40	27.10	20.10	9.70	9.25	6.86	8.60	1.52
55	1.80	2.00	1.60	30.20	29.10	21.70	10.31	9.94	7.41	9.22	1.58
60	1.60	2.00	0.70	31.80	31.10	22.40	10.86	10.62	7.65	9.71	1.79
65	1.80	1.30	1.20	33.60	32.40	23.60	11.47	11.06	8.06	10.20	1.86
70	1.50	1.80	1.00	35.10	34.20	24.60	11.98	11.68	8.40	10.69	1.99
75	1.10	1.40	0.80	36.20	35.60	25.40	12.36	12.15	8.67	11.06	2.07
80	1.90	1.40	0.80	38.10	37.00	26.20	13.01	12.63	8.95	11.53	2.25
85	1.00	1.30	0.90	39.10	38.30	27.10	13.35	13.08	9.25	11.89	2.29
90	1.90	1.40	0.80	41.00	39.70	27.90	14.00	13.55	9.53	12.36	2.46

Table G.4. Water Evaporation from Liquid Crystalline System Composed of Triethanolamine:Oleic acid:Water (15:50:35)

Time (min)	Weight Loss (mg)			Cumulative Weight Loss (mg)			% Cumulative Weight Loss			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
5	2.80	3.40	4.00	2.80	3.40	4.00	1.09	1.32	1.56	1.32	0.23
10	2.70	3.20	3.30	5.50	6.60	7.30	2.14	2.57	2.84	2.52	0.35
15	2.50	2.90	2.60	8.00	9.50	9.90	3.12	3.70	3.86	3.56	0.39
20	1.90	1.90	2.30	9.90	11.40	12.20	3.86	4.44	4.75	4.35	0.45
25	1.80	2.40	2.00	11.70	13.80	14.20	4.56	5.38	5.53	5.16	0.52
30	1.60	1.50	1.80	13.30	15.30	16.00	5.18	5.96	6.23	5.79	0.55
35	1.50	1.50	1.80	14.80	16.80	17.80	5.77	6.54	6.93	6.41	0.60
40	1.40	1.50	1.60	16.20	18.30	19.40	6.31	7.13	7.56	7.00	0.63
45	1.20	1.50	1.20	17.40	19.80	20.60	6.78	7.71	8.02	7.51	0.65
50	1.30	1.50	1.60	18.70	21.30	22.20	7.28	8.30	8.65	8.08	0.71
55	1.20	1.10	1.30	19.90	22.40	23.50	7.75	8.73	9.15	8.54	0.72
60	1.30	1.30	1.30	21.20	23.70	24.80	8.26	9.23	9.66	9.05	0.72
65	0.90	1.00	1.20	22.10	24.70	26.00	8.61	9.62	10.13	9.45	0.77
70	1.30	1.20	1.40	23.40	25.90	27.40	9.12	10.09	10.67	9.96	0.79
75	1.10	1.00	0.90	24.50	26.90	28.30	9.54	10.48	11.02	10.35	0.75
80	0.90	1.20	1.30	25.40	28.10	29.60	9.89	10.95	11.53	10.79	0.83
85	1.30	1.10	1.20	26.70	29.20	30.80	10.40	11.38	12.00	11.26	0.80
90	0.60	0.80	1.00	27.30	30.00	31.80	10.63	11.69	12.39	11.57	0.88

Table G.5. Water Evaporation from Liquid Crystalline System Composed of SDS:Decanol:Water (20:30:50)

Time (min)	Weight Loss (mg)			Cumulative Weight Loss (mg)			% Cumulative Weight Loss			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
5	3.90	2.90	3.80	3.90	2.90	3.80	1.07	0.80	1.04	0.97	0.15
10	2.80	4.00	2.50	6.70	6.90	6.30	1.84	1.89	1.73	1.82	0.08
15	2.40	2.50	2.00	9.10	9.40	8.30	2.50	2.58	2.28	2.45	0.16
20	2.00	2.40	1.90	11.10	11.80	10.20	3.04	3.24	2.80	3.03	0.22
25	2.10	2.10	1.50	13.20	13.90	11.70	3.62	3.81	3.21	3.55	0.31
30	1.90	1.90	1.90	15.10	15.80	13.60	4.14	4.33	3.73	4.07	0.31
35	1.90	1.90	1.80	17.00	17.70	15.40	4.66	4.85	4.22	4.58	0.32
40	1.70	2.10	1.70	18.70	19.80	17.10	5.13	5.43	4.69	5.08	0.37
45	1.80	2.20	1.60	20.50	22.00	18.70	5.62	6.03	5.13	5.59	0.45
50	1.70	2.50	1.70	22.20	24.50	20.40	6.09	6.72	5.59	6.13	0.57
55	1.90	2.30	1.60	24.10	26.80	22.00	6.61	7.35	6.03	6.66	0.66
60	2.50	2.40	1.90	26.60	29.20	23.90	7.29	8.01	6.55	7.28	0.73
65	1.80	2.80	2.10	28.40	32.00	26.00	7.79	8.77	7.13	7.90	0.83
70	2.50	2.80	1.80	30.90	34.80	27.80	8.47	9.54	7.62	8.54	0.96
75	2.30	3.10	2.00	33.20	37.90	29.80	9.10	10.39	8.17	9.22	1.11
80	2.60	2.70	2.00	35.80	40.60	31.80	9.82	11.13	8.72	9.89	1.21
85	2.10	3.20	2.10	37.90	43.80	33.90	10.39	12.01	9.30	10.57	1.36
90	2.80	3.20	2.40	40.70	47.00	36.30	11.16	12.89	9.95	11.33	1.48

Table G.6. Water Evaporation from Liquid Crystalline System Composed of Lecithin:Water (40:60)

Time (min)	Weight Loss (mg)			Cumulative Weight Loss (mg)			% Cumulative Weight Loss			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
5	8.70	7.30	5.30	8.70	7.30	5.30	2.44	2.05	1.49	1.99	0.48
10	6.10	6.20	5.30	14.80	13.50	10.60	4.15	3.78	2.97	3.63	0.60
15	4.90	5.40	5.40	19.70	18.90	16.00	5.52	5.30	4.48	5.10	0.55
20	4.20	4.30	4.50	23.90	23.20	20.50	6.70	6.50	5.75	6.32	0.50
25	3.80	4.10	4.20	27.70	27.30	24.70	7.76	7.65	6.92	7.44	0.46
30	3.40	3.40	3.80	31.10	30.70	28.50	8.72	8.60	7.99	8.44	0.39
35	3.30	3.70	3.40	34.40	34.40	31.90	9.64	9.64	8.94	9.41	0.40
40	3.10	3.20	3.30	37.50	37.60	35.20	10.51	10.54	9.87	10.31	0.38
45	2.70	2.70	2.80	40.20	40.30	38.00	11.27	11.29	10.65	11.07	0.36
50	2.70	3.10	3.00	42.90	43.40	41.00	12.02	12.16	11.49	11.89	0.35
55	2.50	2.50	3.00	45.40	45.90	43.00	12.72	12.86	12.05	12.54	0.43
60	2.70	2.50	2.50	48.10	48.40	45.50	13.48	13.57	12.75	13.27	0.45
65	2.20	2.40	2.50	50.30	50.80	48.00	14.10	14.24	13.45	13.93	0.42
70	2.20	2.40	2.40	52.50	53.20	50.40	14.71	14.91	14.13	14.58	0.41
75	2.30	2.60	2.60	54.80	55.80	53.00	15.36	15.64	14.85	15.28	0.40
80	1.90	2.10	2.10	56.70	57.90	55.10	15.89	16.23	15.44	15.85	0.40
85	2.20	2.40	2.50	58.90	60.30	57.60	16.51	16.90	16.14	16.52	0.38
90	2.20	2.00	2.30	61.10	62.30	59.90	17.12	17.46	16.79	17.12	0.34

Table G.7. Water Evaporation from Liposomal System

Time (min)	Weight Loss (mg)			Cumulative Weight Loss (mg)			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3		
5	7.90	8.80	7.00	7.90	8.80	7.00	7.90	0.90
10	7.60	7.80	6.40	15.50	16.60	13.40	15.17	1.63
15	7.50	6.70	6.60	23.00	23.30	20.00	22.10	1.82
20	7.10	6.20	5.80	30.10	29.50	25.80	28.47	2.33
25	6.40	5.50	5.60	36.50	35.00	31.40	34.30	2.62
30	6.10	4.90	5.60	42.60	39.90	37.00	39.83	2.80
35	5.70	5.00	5.20	48.30	44.90	42.20	45.13	3.06
40	5.60	4.10	4.90	53.90	49.00	47.10	50.00	3.51
45	5.30	4.30	4.80	59.20	53.30	51.90	54.80	3.87
50	5.20	3.40	4.90	64.40	56.70	56.80	59.30	4.42
55	5.10	3.60	4.50	69.50	60.30	61.30	63.70	5.05
60	4.40	3.60	4.30	73.90	63.90	65.60	67.80	5.35
65	4.80	3.20	4.20	78.70	67.10	69.80	71.87	6.07
70	4.50	2.90	4.30	83.20	70.00	74.10	75.77	6.76
75	4.40	2.90	4.20	87.60	72.90	78.30	79.60	7.44
80	4.20	3.10	3.80	91.80	76.00	82.10	83.30	7.97
85	4.10	3.10	4.20	95.90	79.10	86.30	87.10	8.43
90	4.30	2.50	3.70	100.20	81.60	90.00	90.60	9.31

Table G.8. Water Evaporation from nonionic cream base

Time (min)	Weight Loss (mg)			Cumulative Weight Loss (mg)			% Cumulative Weight Loss			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
5	0.80	0.50	1.10	0.80	0.50	1.10	0.17	0.11	0.23	0.17	0.06
10	3.50	4.10	2.90	4.30	4.60	4.00	0.91	0.97	0.84	0.91	0.07
15	4.00	3.80	3.10	8.30	8.40	7.10	1.75	1.77	1.50	1.67	0.15
20	4.10	3.90	3.10	12.40	12.30	10.20	2.61	2.59	2.15	2.45	0.26
25	4.00	4.00	3.10	16.40	16.30	13.30	3.46	3.43	2.80	3.23	0.37
30	3.80	3.60	3.00	20.20	19.90	16.30	4.26	4.19	3.43	3.96	0.46
35	3.50	2.90	3.10	23.70	22.80	19.40	4.99	4.80	4.09	4.63	0.47
40	3.70	3.70	2.90	27.40	26.50	22.30	5.77	5.58	4.70	5.35	0.57
45	3.20	2.70	2.90	30.60	29.20	25.20	6.45	6.15	5.31	5.97	0.59
50	2.80	2.90	2.50	33.40	32.10	27.70	7.04	6.76	5.84	6.55	0.63
55	2.80	2.70	2.90	36.20	34.80	30.60	7.63	7.33	6.45	7.14	0.61
60	2.60	2.40	2.20	38.80	37.20	32.80	8.18	7.84	6.91	7.64	0.66
65	2.60	2.30	2.60	41.40	39.50	35.40	8.72	8.32	7.46	8.17	0.64
70	2.50	2.00	2.30	43.90	41.50	37.70	9.25	8.74	7.94	8.64	0.66
75	2.90	2.30	2.70	46.80	43.80	40.40	9.86	9.23	8.51	9.20	0.68
80	2.20	2.10	1.80	49.00	45.90	42.20	10.32	9.67	8.89	9.63	0.72
85	2.30	2.00	1.90	51.30	47.90	44.10	10.81	10.09	9.29	10.06	0.76
90	2.20	1.60	1.90	53.50	49.50	46.00	11.27	10.43	9.69	10.46	0.79

Table G.9. Water Evaporation from Bulk Water

Time (min)	Weight Loss (mg)			Cumulative Weight Loss (mg)			% Cumulative Weight Loss			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
5	4.20	1.70	2.10	4.20	1.70	2.10	0.81	0.33	0.41	0.52	0.26
10	8.20	9.40	7.10	12.40	11.10	9.20	2.40	2.15	1.78	2.11	0.31
15	9.50	8.30	7.10	21.90	19.40	16.30	4.24	3.75	3.15	3.71	0.55
20	8.80	8.40	7.30	30.70	27.80	23.60	5.94	5.38	4.57	5.30	0.69
25	8.90	9.00	7.10	39.60	36.80	30.70	7.66	7.12	5.94	6.91	0.88
30	8.80	8.60	7.00	48.40	45.40	37.70	9.37	8.79	7.30	8.49	1.07
35	8.50	8.40	7.10	56.90	53.80	44.80	11.01	10.41	8.67	10.03	1.22
40	8.80	8.70	7.40	65.70	62.50	52.20	12.71	12.10	10.10	11.64	1.37
45	8.50	8.70	7.00	74.20	71.20	59.20	14.36	13.78	11.46	13.20	1.53
50	8.70	8.10	7.20	82.90	79.30	66.40	16.04	15.35	12.85	14.75	1.68
55	8.60	8.20	7.50	91.50	87.50	73.90	17.71	16.93	14.30	16.31	1.79
60	8.70	7.90	7.00	100.20	95.40	80.90	19.39	18.46	15.66	17.84	1.94
65	8.40	8.00	7.30	108.60	103.40	88.20	21.02	20.01	17.07	19.37	2.05
70	8.50	7.40	7.50	117.10	110.80	95.70	22.66	21.44	18.52	20.87	2.13
75	8.30	8.10	7.20	125.40	118.90	102.90	24.27	23.01	19.91	22.40	2.24
80	8.50	7.70	7.50	133.90	126.60	110.40	25.91	24.50	21.37	23.93	2.32
85	7.80	7.70	7.60	141.70	134.30	118.00	27.42	25.99	22.84	25.42	2.34
90	8.50	7.30	6.90	150.20	141.60	124.90	29.07	27.40	24.17	26.88	2.49

APPENDIX H

Validation for the Quantitative Determination of PTU Released From the Liquid Crystalline System by UV Spectroscopy

The parameters evaluated to ensure the acceptability of the performance of the selected analytical method were accuracy, precision, specificity and linearity (USP XXI).

1. Accuracy

PTU solutions were prepared at 50, 150, and 300 µg/ml.Three sets of each concentration were prepared. Each individual sample was analyzed by UV spectrophotometry, and percent analytical recovery of each sample was calculated.

2. Precision

2.1 Within Run Precision

The within run precision was determined by analyzing of three sets of the calibration curve in the same day. Inverse concentrations of PTU were compared, and the percent coefficient of variation (% CV) for each concentration was calculated.

2.2 **Between Run Precision**

The between run precision was determined by comparing each concentration of three sets of the calibration curve prepared on different days for six days. Inverse concentration for the three standard curves on different days were determined and the percent coefficient of variation (% CV) for each concentration was calculated.

3. Specificity

Under the condition selected for in vitro PTU release studies, the peaks of other components in the liquid crystalline systems must not interfere with the peak of PTU. This validation was made by comparing the peak scan from UV spectrophotometer between the receptor fluid taken from no the liquid crystalline system without incorporated PTU with the one taken from the drug-containing system of the similar composition.

4. Linearity

Linear regression analysis of the absorbances versus the corresponding concentrations was performed, and the coefficient of determination was calculated.

The results of validation process are as in the following tables:

H.1. Accuracy

Table H.1. Accuracy Data

Expected Concentration (μg/ml)	Analytical Concentration (μg/ml)	% Recovery
50.00	50.30	100.60
	52.10	104.20
	48.80	97.60
150.00	159.50	106.33
	148.00	98.67
	154.00	102.67
300.00	310.00	103.33
	317.00	105.67
	298.00	99.33

Mean % Recovery = 102.04, SD= 3.14, %CV = 3.08

H.2. Precision

H.2.1. Within Run Precision

Table H.2.1. Within Run Precision Data

Concentration (μg/ml)	Absorbance					
	n_1	n_2	n_3	n_4	n_5	n_6
0.72	0.080	0.072	0.077	0.073	0.076	0.077
1.44	0.150	0.141	0.150	0.145	0.143	0.148
2.88	0.295	0.284	0.291	0.281	0.281	0.289
4.32	0.437	0.427	0.430	0.415	0.421	0.422
5.76	0.576	0.564	0.567	0.552	0.568	0.561
7.20	0.726	0.707	0.714	0.699	0.705	0.716
8.64	0.865	0.842	0.856	0.833	0.843	0.852
R^2	0.9999	0.9999	0.9999	0.9999	1	0.9997

Concentration (μg/ml)	Inverse Concentration						Mean	SD	% CV
	n_1	n_2	n_3	n_4	n_5	n_6			
0.72	0.73	0.71	0.71	0.72	0.74	0.73	0.720	0.012	1.68
1.44	1.43	1.42	1.46	1.47	1.43	1.46	1.445	0.021	1.45
2.88	2.89	2.89	2.89	2.89	2.85	2.90	2.885	0.018	0.61
4.32	4.32	4.35	4.31	4.28	4.29	4.26	4.302	0.032	0.74
5.76	5.72	5.76	5.71	5.71	5.80	5.68	5.730	0.043	0.75
7.20	7.23	7.22	7.21	7.25	7.21	7.26	7.230	0.021	0.29
8.64	8.63	8.61	8.66	8.64	8.63	8.65	8.637	0.017	0.20

H.2.2 Between Run Precision

Table H.2.2. Between Run Precision Data

Conc. (µg/ml)	Absorbance																	
	Day 1			Day 2			Day 3			Day 4			Day 5			Day 6		
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3
0.72	0.080	0.072	0.077	0.069	0.074	0.068	0.070	0.071	0.067	0.072	0.073	0.075	0.070	0.069	0.072	0.073	0.073	0.074
1.44	0.150	0.141	0.150	0.140	0.144	0.136	0.140	0.141	0.136	0.145	0.145	0.147	0.139	0.140	0.143	0.151	0.147	0.149
2.88	0.295	0.284	0.291	0.280	0.282	0.278	0.284	0.279	0.279	0.285	0.285	0.286	0.277	0.287	0.280	0.283	0.289	0.287
4.32	0.437	0.427	0.430	0.417	0.425	0.416	0.421	0.415	0.415	0.421	0.421	0.431	0.417	0.426	0.422	0.425	0.428	0.429
5.76	0.576	0.564	0.567	0.557	0.561	0.548	0.561	0.552	0.555	0.567	0.568	0.575	0.558	0.565	0.555	0.558	0.563	0.568
7.20	0.726	0.707	0.714	0.699	0.709	0.691	0.711	0.697	0.702	0.705	0.719	0.715	0.702	0.707	0.698	0.709	0.723	0.713
8.64	0.865	0.842	0.856	0.829	0.847	0.827	0.847	0.833	0.839	0.847	0.848	0.856	0.834	0.850	0.837	0.844	0.854	0.857
R^2	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9997	0.9999	0.9999	0.9999	0.9999	0.9998	0.9997	0.9999

Table H.2.2. (continued)

Conc. (µg/ml)	Inverse Concentration																		Mean	SD	%CV
	Day 1			Day 2			Day 3			Day 4			Day 5			Day 6					
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3			
0.72	0.73	0.71	0.71	0.70	0.73	0.71	0.72	0.72	0.73	0.71	0.72	0.72	0.73	0.70	0.71	0.69	0.71	0.71	0.714	0.011	1.54
1.44	1.43	1.42	1.46	1.44	1.45	1.42	1.44	1.45	1.43	1.46	1.46	1.45	1.44	1.42	1.45	1.50	1.46	1.47	1.447	0.020	1.38
2.88	2.89	2.89	2.89	2.89	2.86	2.90	2.90	2.88	2.90	2.89	2.88	2.85	2.86	2.92	2.87	2.86	2.90	2.87	2.883	0.018	0.62
4.32	4.32	4.35	4.31	4.32	4.32	4.34	4.30	4.30	4.29	4.28	4.26	4.32	4.31	4.33	4.34	4.32	4.30	4.31	4.312	0.022	0.51
5.76	5.72	5.76	5.71	5.77	5.72	5.72	5.72	5.72	5.73	5.78	5.75	5.78	5.76	5.74	5.72	5.69	5.67	5.73	5.733	0.030	0.52
7.20	7.23	7.22	7.21	7.24	7.23	7.21	7.25	7.23	7.23	7.19	7.29	7.20	7.25	7.19	7.21	7.25	7.29	7.20	7.229	0.029	0.40
8.64	8.63	8.61	8.66	8.59	8.64	8.63	8.63	8.64	8.64	8.65	8.60	8.63	8.61	8.64	8.65	8.64	8.62	8.66	8.632	0.019	0.22

H.3. Specificity

The UV Spectra from UV spectrophotometer of the receptor fluid taken from non-drug containing liquid crystalline systems (no dilution)

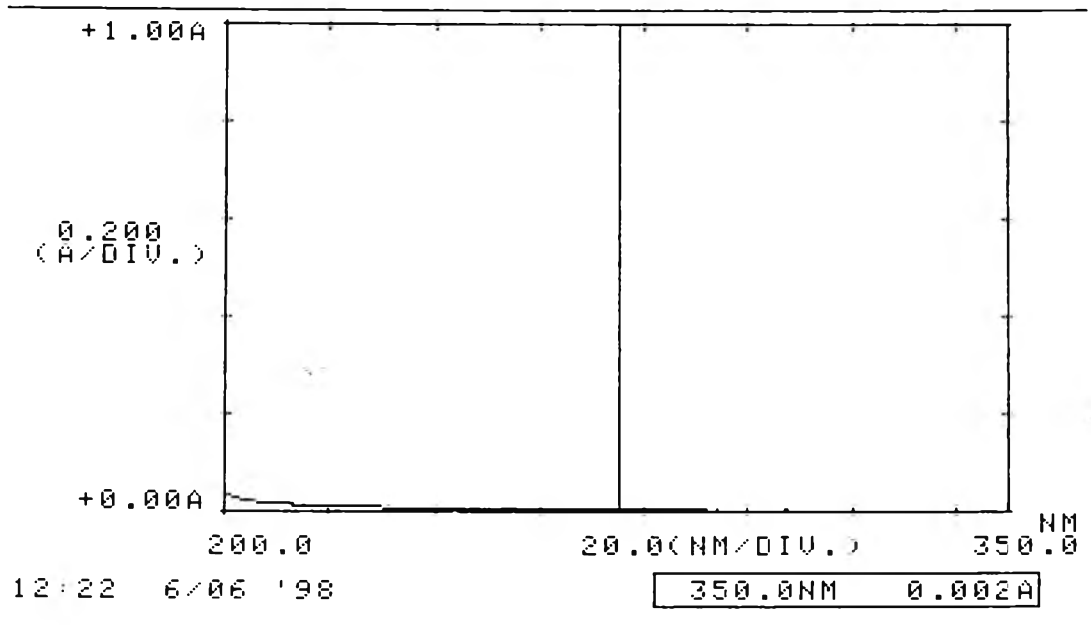


Figure H.3.1. The Liquid Crystalline System Composed of Brij®72:Arlamol®E:Water (15:10:75).

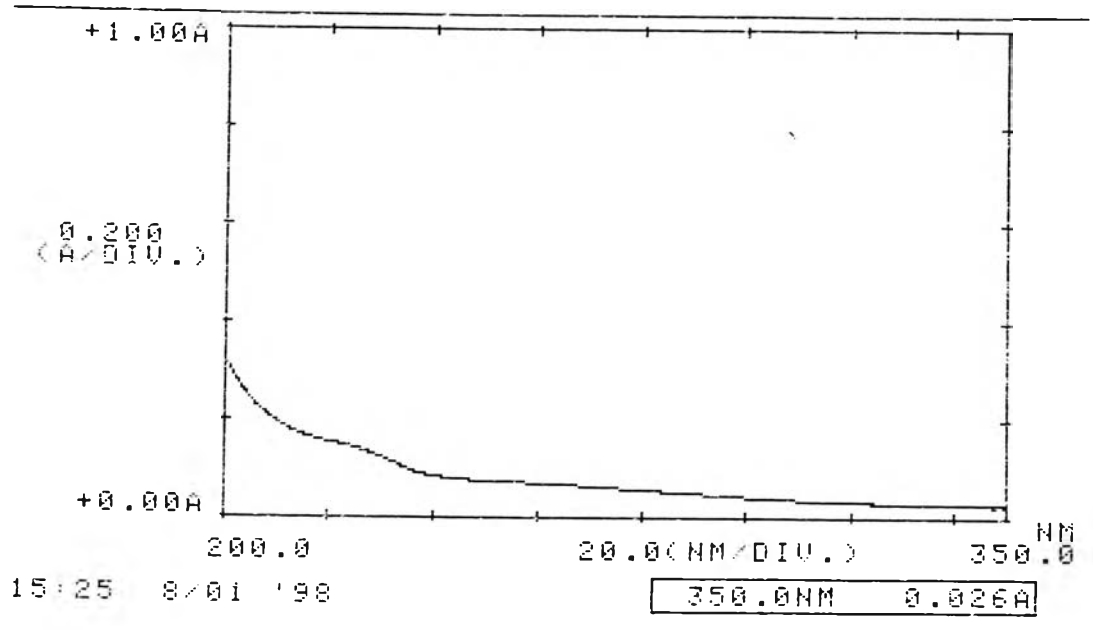


Figure H.3.2. The Liquid Crystalline System Composed of Triethanolamine:Oleic acid: Water (10:50:40).

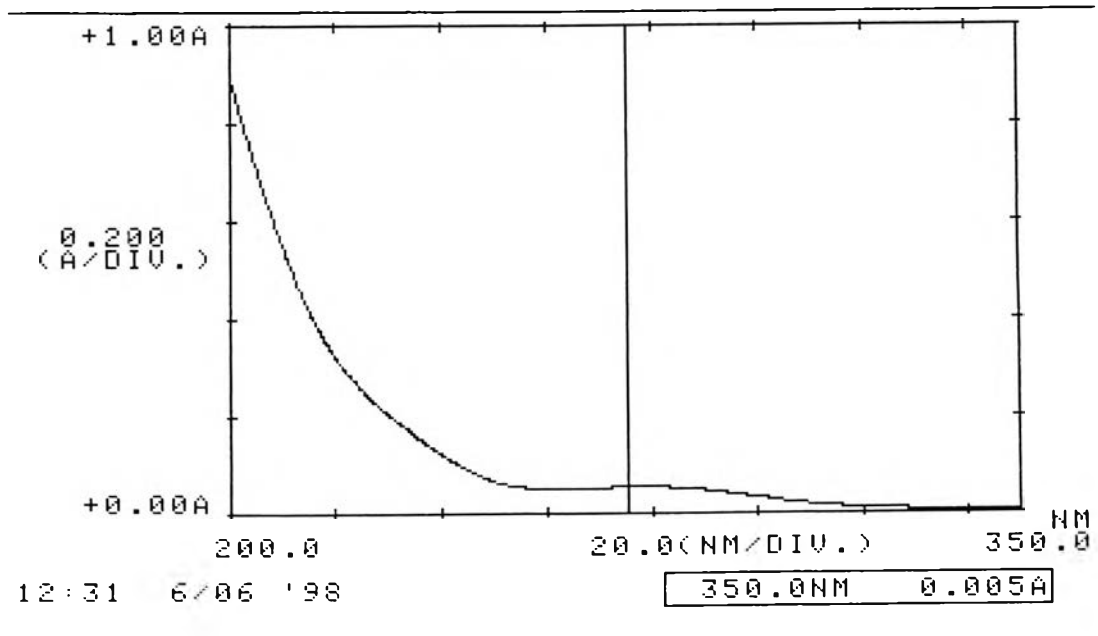


Figure H.3.3. The Liquid Crystalline System Composed of Triethanolamine:Oleic acid: Water (15:50:35).

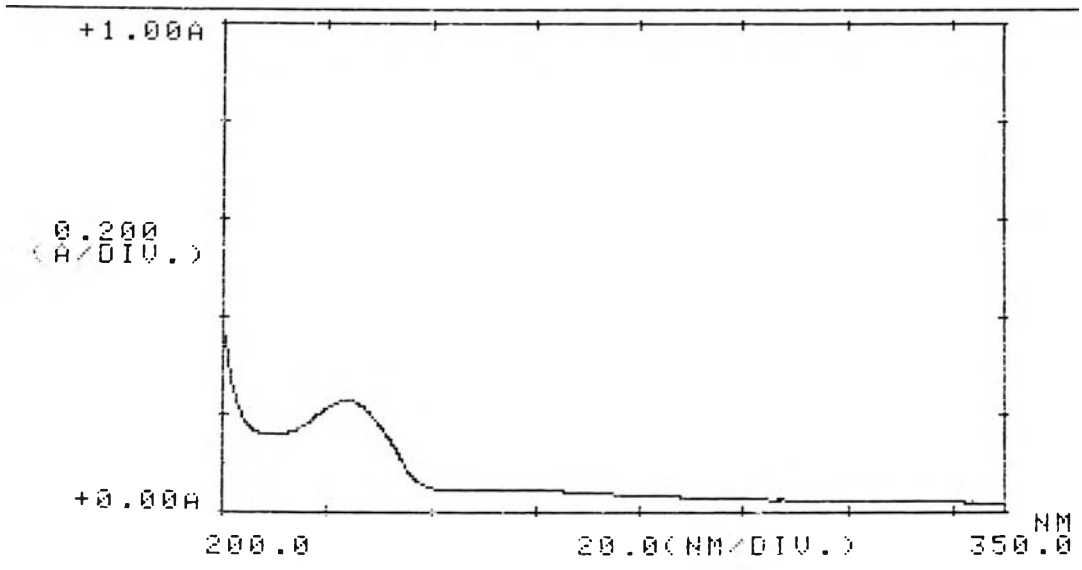


Figure H.3.4. The Liquid Crystalline System Composed of SDS:Decanol:Water (20:30:50).

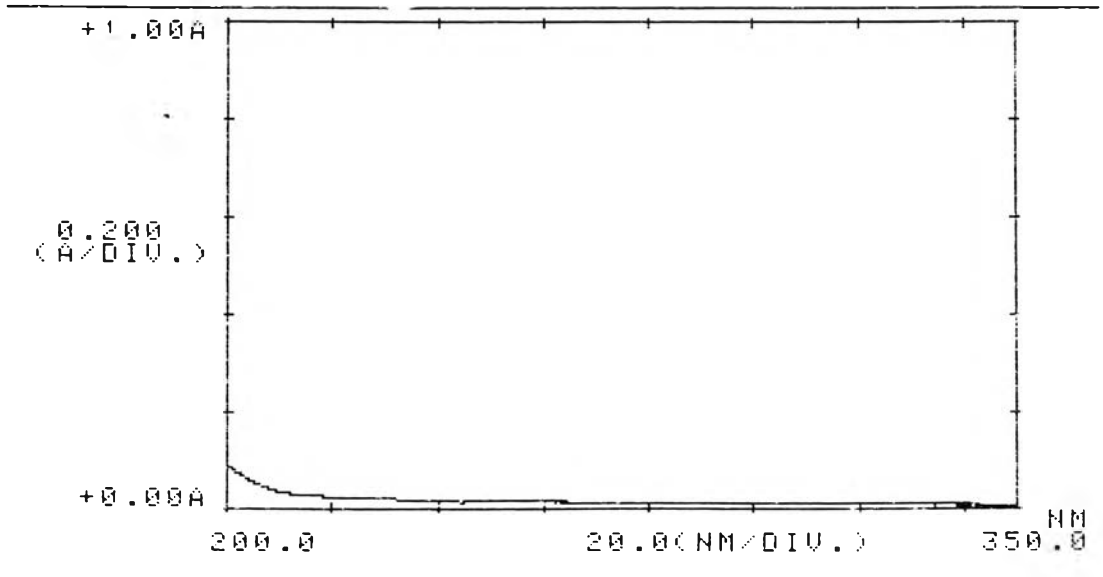
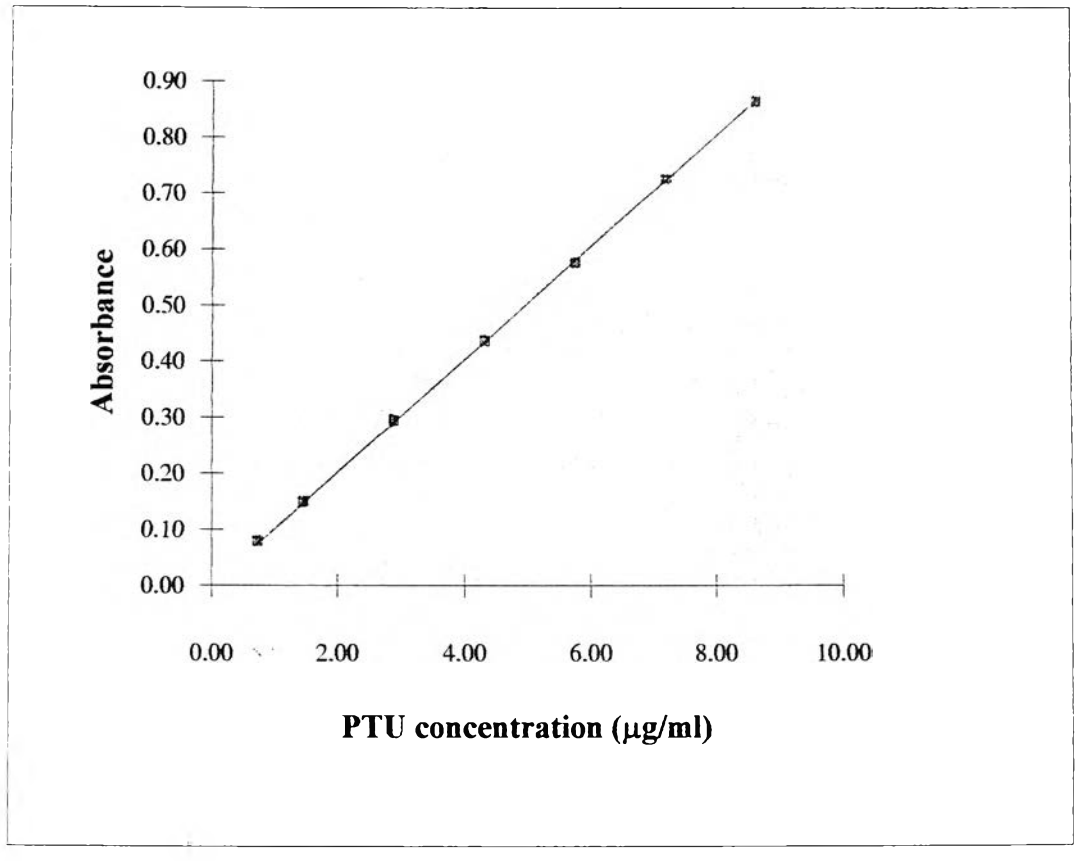


Figure H.3.5. The Liquid Crystalline System Composed of Lecithin:Water (40:60).

H.4. Linearity



$y = 0.0993x - 0.0079$; $R^2 = 0.9999$

where y = Absorbance

x = PTU Concentration (µg/ml)

Figure H.4. A representation of calibration curve of standard solution of PTU

APPENDIX I

Preparation of Standard Curve for Release Studies

A solution of PTU was prepared by dissolving 45.0 mg of PTU in Sorensen phosphate buffer pH 6.5 in a 50-ml volumetric flask. The solution was adjusted to volume, giving the final concentration of 900 μg/ml. Two milliliters of the solution was transferred to the second 50-ml volumetric flask. The solution was adjusted to volume, giving the final concentration of 36 μg/ml. Standard solutions were prepared by pipetting 0.5, 1, 2, 3, 4, 5, and 6 ml of 36 μg/ml PTU solution and transferring each aliquot to each one of seven 25-ml volumetric flasks. The solutions were adjusted to volume with the buffer so that the concentrations of the standard solution were 0.72, 1.44, 2.88, 4.32, 5.76, 7.2, and 8.64 μg/ml, respectively.

APPENDIX J

Release of PTU in pH 6.5 Sorensen Buffer from Lyotropic Liquid Crystalline Systems, Nonionic Cream Base, and Aqueous Solution at 37^{0}C

J.1. Calibration data for Release Studies

Table J.1.1. Calibration Data for Liquid Crystalline System Composed of Brij®72: Arlamole®E:Water (15:10:75) and Aqueous Solution.

Concentration (μg/ml)	0.72	1.44	2.88	4.32	5.76	7.20	8.64
Absorbance	0.069	0.142	0.288	0.427	0.568	0.714	0.851

$y = 0.0987x - 0.0002$; $R^2 = 0.9999$

Table J.1.2. Calibration Data for Liquid Crystalline System Composed of Triethanolamine:Oleic acid:Water (10:50:40).

Concentration (μg/ml)	0.72	1.44	2.88	4.32	5.76	7.20	8.64
Absorbance at 270.2 nm	0.070	0.151	0.302	0.448	0.601	0.756	0.899
at 274.2 nm	0.072	0.154	0.309	0.458	0.613	0.772	0.918

$y = 0.1047x - 0.0019$; $R^2 = 0.9999$

$y = 0.1068x - 0.0016$; $R^2 = 0.9999$

Table J.1.3. Calibration Data for Liquid Crystalline System Composed of Triethanolamine:Oleic acid:Water (15:50:40)

Concentration (μg/ml)	0.72	1.44	2.88	4.32	5.76	7.20	8.64
Absorbance at 270.2 nm	0.070	0.145	0.284	0.427	0.558	0.700	0.835
at 274.2 nm	0.073	0.148	0.290	0.428	0.570	0.715	0.854

$y = 0.0963x - 0.0051$; $R^2 = 0.9999$

$y = 0.0984x - 0.0044$; $R^2 = 0.9999$

Table J.1.4. Calibration Data for Liquid Crystalline System Composed of SDS: Decanol:Water (20:30:50)

Concentration (μg/ml)	0.72	1.44	2.88	4.32	5.76	7.20	8.64
Absorbance	0.074	0.148	0.290	0.428	0.569	0.714	0.852

$y = 0.0981x - 0.0053$; $R^2 = 0.9999$

Table J.1.5. Calibration Data for Liquid Crystalline System Composed of Lecithin: Water (40:60)

Concentration (μg/ml)	0.72	1.44	2.88	4.32	5.76	7.20	8.64
Absorbance	0.074	0.147	0.290	0.429	0.572	0.719	0.854

$y = 0.0987x - 0.0043$; $R^2 = 0.9999$

Table J.1.6. Calibration Curve Data for Liposomal system

Concentration (µg/ml)	0.72	1.44	2.88	4.32	5.76	7.20	8.64
Absorbance	0.075	0.149	0.290	0.429	0.569	0.717	0.856

$y = 0.0985x - 0.0052$; $R^2 = 0.9999$

Table J.1.7. Nonionic Cream Base

Concentration (µg/ml)	0.72	1.44	2.88	4.32	5.76	7.20	8.64
Absorbance	0.074	0.147	0.287	0.432	0.568	0.714	0.852

$y = 0.0982x - 0.0047$; $R^2 = 0.9999$

J.2. Release of PTU

Table J.2.1. Liquid Crystalline System Composed of Brij®72:Arlamol®E:Water (15:10:75) (PTU content = 1,200 μg)

Time (hr)	Absorbance			Amount of PTU (mcg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	0.474	0.527	0.500	54.86	61.40	58.14	4.57	5.12	4.84	4.84	0.27
1	0.258	0.297	0.273	77.83	87.86	82.31	6.48	7.32	6.86	6.89	0.42
2	0.306	0.632	0.332	109.53	125.46	116.81	9.13	10.45	9.73	9.77	0.66
4	0.417	0.485	0.434	153.33	176.46	162.24	12.78	14.70	13.52	13.67	0.97
6	0.351	0.402	0.363	187.88	215.89	197.87	15.66	17.99	16.49	16.71	1.18
8	0.298	0.348	0.307	217.20	250.25	228.13	18.10	20.85	19.01	19.32	1.40
12	0.439	0.506	0.439	263.65	303.88	274.51	21.97	25.32	22.87	23.39	1.37
16	0.398	0.450	0.396	303.36	348.52	313.97	25.28	29.04	26.16	26.83	1.97
20	0.349	0.390	0.342	337.95	387.10	347.75	28.16	32.26	28.98	29.80	2.17
24	0.311	0.353	0.306	368.90	422.23	378.22	30.74	35.18	31.52	32.48	2.37
Receptor volume (ml)	11.43	11.52	11.49								

Table J.2.2. Aqueous Solution (PTU content = 1405 μg)

Time (hr)	0.5	1	2	4	6	8	12	16	20	24
Absorbance	0.491	0.394	0.491	0.876	0.353	0.538	0.162	0.052	0.023	0.020
Amount of PTU (μg/ml)	316.85	502.85	764.85	1261.96	1367.59	1387.36	1393.31	1395.43	1396.93	1398.43
% Release	22.55	35.79	54.44	89.82	97.34	98.74	99.17	99.32	99.42	99.53

Table J.2.3. Liquid Crystalline System Composed of Triethanolamine:Oleic:Water (10:50:40) (PTU content = 4,500 μg)

Time (hr)		0.5	1	2	4	6	8	12	16	20	24
Absorbance of sample	n_1	0.488	0.328	0.443	0.666	0.590	0.506	0.717	0.591	0.477	0.405
at 270.2 nm	n_2	0.538	0.372	0.535	0.713	0.624	0.558	0.743	0.672	0.552	0.485
	n_3	0.539	0.358	0.494	0.669	0.587	0.499	0.724	0.656	0.546	0.463
Absorbance of sample	n_1	0.472	0.318	0.430	0.644	0.568	0.485	0.683	0.561	0.449	0.377
at 274.2 nm	n_2	0.521	0.362	0.520	0 691	0.565	0.543	0.716	0.642	0.521	0.458
	n_3	0.525	0.350	0.484	0.652	0.570	0.483	0.698	0.629	0.519	0.437
Absorbance of control at 270.2 nm		0.027	0.022	0.028	0.024	0.024	0.023	0.038	0.048	0.046	0.051
at 274.2 nm		0.026	0.022	0.027	0.023	0.023	0..022	0.037	0.047	0.046	0.051

Table J.2.3. (Continued)

Time (hr)	ΔAbsorbance (270.2 nm.)			Amount of PTU (μg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	0.461	0.511	0.512	101.84	112.01	112.83	2.26	2.49	2.51	2.42	0.14
1	0.306	0.350	0.336	156.14	174.81	172.42	3.47	3.88	3.83	3.73	0.22
2	0.415	0.507	0.466	238.90	276.30	265.52	5.31	6.14	5.90	5.78	0.43
4	0.642	0.689	0.645	368.50	413.28	394.22	8.19	9.18	8.76	8.71	0.50
6	0.566	0.600	0.563	474.68	525.84	499.89	10.55	11.68	11.11	11.11	0.56
8	0.483	0.535	0.476	564.87	626.67	588.82	12.55	13.93	13.08	13.19	0.70
12	0.679	0.705	0.686	700.56	766.30	150.98	15.57	17.03	16.14	16.25	0.73
16	0.543	0.624	0.608	800.84	883.70	840.57	17.80	19.64	18.68	18.71	0.92
20	0.431	0.506	0.500	880.38	977.47	933.27	19.56	21.72	20.74	20.67	1.08
24	0.354	0.434	0.412	946.14	1058.70	1009.77	21.02	23.53	22.44	22.33	1.26
Receptor volume (ml)	11.52	11.43	11.49								

Table J.2.3. (Continued)

Time (hr)	ΔAbsorbance (274.2nm.)			Amount of PTU (μg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	0.446	0.495	0.499	96.54	106.3	107.78	2.30	2.36	2.39	2.35	0.04
1	0.296	0.340	0.328	147.85	129.58	164.58	3.28	3.69	3.66	3.54	0.23
2	0.403	0.493	0.457	226.72	262.84	253.98	5.04	5.84	5.64	5.51	0.42
4	0.621	0.668	0.629	349.52	392.93	376.78	7.77	8.73	8.37	8.29	0.48
6	0.545	0.542	0.547	449.76	491.36	477.09	9.99	10.92	10.60	10.50	0.47
8	0.463	0.521	0.461	534.42	588.58	561.3	11.88	13.08	12.47	12.48	0.60
12	0.646	0.679	0.661	660.73	720.22	690.88	14.68	16.00	15.35	15.34	0.66
16	0.514	0.595	0.582	753.68	829.56	797.87	16.75	18.43	17.73	17.64	0.84
20	0.403	0.475	0.473	826.32	915.55	883.63	18.36	20.34	19.64	19.45	1.00
24	0.326	0.407	0.386	885.53	990.12	953.62	19.68	22.00	21.20	20.96	1.18
Receptor volume (ml)	11.52	11.43	11.49								

Table J.2.4. Liquid Crystalline System Composed of Triethanolamine:Oleic:Water (15:50:40) (PTU content = 3,600 μg)

Time (hr)		1/2	1	2	4	6	8	12	16	20	24
Absorbance of sample	n_1	0.257	0.195	0.233	0.329	0.242	0.215	0.395	0.242	0.244	0.213
at 270.2 nm	n_2	0.218	0.163	0.200	0.295	0.257	0.223	0.409	0.253	0.255	0.221
	n_3	0.190	0.170	0.204	0.275	0.235	0.205	0.378	0.224	0.211	0.187
Absorbance of sample	n_1	0.250	0.191	0.227	0.319	0.235	0.208	0.378	0.231	0.231	0.199
at 274.2 nm	n_2	0.208	0.156	0.191	0.281	0.245	0.212	0.388	0.240	0.240	0.207
	n_3	0.178	0.160	0.193	0.261	0.223	0.193	0.355	0.208	0.194	0.170
Absorbance of control at 270.2 nm		0.015	0.011	0.013	0.019	0.024	0.023	0.034	0.025	0.028	0.024
at 274.2 nm		0.014	0.011	0.013	0.018	0.023	0.022	0.034	0.025	0.027	0.024

Table J.2.4. (Continued)

Time (hr)	ΔAbsorbance (270.2 nm)			Amount of PTU (μg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	0.242	0.203	0.175	141.33	117.16	101.38	3.92	3.25	2.82	3.33	0.55
1	0.184	0.152	0.159	229.86	189.37	180.16	6.38	5.26	5.00	5.54	0.73
2	0.220	0.187	0.191	344.11	286.51	279.17	9.56	7.96	7.75	8.42	0.99
4	0.310	0.276	0.256	509.04	433.59	414.26	14.14	12.04	11.51	12.56	1.39
6	0.218	0.233	0.211	612.46	548.37	517.76	17.01	15.23	14.38	15.54	1.34
8	0.192	0.200	0.182	707.45	646.94	606.91	19.65	17.97	16.86	18.16	1.40
12	0.361	0.375	0.344	904.99	851.96	795.75	25.14	23.66	22.10	23.63	1.52
16	0.217	0.228	0.199	1003.89	956.52	884.78	27.88	26.57	24.58	26.34	1.66
20	0.216	0.227	0.183	1113.31	1071.44	975.48	30.92	29.76	27.10	29.26	1.96
24	0.189	0.197	0.163	1206.73	1168.73	1055.96	33.52	32.46	29.33	31.77	2.18
Receptor volume (ml)	11.49	11.43	11.52								

Table J.2.4. (Continued)

Time (hr)	ΔAbsorbance (274.2nm.)			Amount of PTU (μg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	0.236	0.194	0.164	135.00	110.30	93.31	3.75	3.06	2.59	3.13	0.58
1	0.180	0.145	0.149	219.76	178.22	165.67	6.10	4.95	4.60	5.22	0.78
2	0.214	0.178	0.180	328.87	268.58	257.03	9.13	7.46	7.14	7.91	1.07
4	0.301	0.263	0.243	485.92	406.30	382.89	13.50	11.29	10.63	11.81	1.50
6	0.212	0.222	0.200	584.72	513.80	479.12	16.24	14.27	13.31	14.61	1.49
8	0.186	0.190	0.171	674.71	605.44	561.31	18.74	16.82	15.59	17.05	1.59
12	0.344	0.354	0.321	859.20	794.88	733.97	23.87	22.08	20.39	22.11	1.74
16	0.206	0.215	0.183	951.27	891.80	813.76	26.42	24.77	22.60	24.60	1.91
20	0.204	0.213	0.167	1052.62	997.66	895.04	29.24	27.71	24.86	27.27	2.22
24	0.175	0.183	0.146	1136.89	1085.94	965.44	31.58	30.16	26.82	29.52	2.44
Receptor volume (ml)	11.49	11.43	11.52								

Table J.2.5. Liquid Crystalline System Composed of SDS:Decanol:Water (20:30:50) (PTU content = 1,200 μg)

Time (hr)		1/2	1	2	4	6	8	12	16	20	24
Absorbance of sample	n_1	0.444	0.355	0.428	0.719	0.675	0.604	0.891	0.846	0.769	0.690
	n_2	0.538	0.360	0.504	0.820	0.740	0.650	0.962	0.897	0.783	0.688
	n_3	0.445	0.386	0.510	0.788	0.738	0.656	0.959	0.878	0.775	0.684
Absorbance of control		0.033	0.012	0.019	0.013	0.004	0.002	0.008	0.003	0.003	0.003

Table J.2.5. (Continued)

Time (hr)	ΔAbsorbance			Amount of PTU (μg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	0.411	0.505	0.412	52.66	63.06	52.87	4.39	5.25	4.40	4.68	0.50
1	0.343	0.348	0.374	85.16	94.14	89.41	7.10	7.84	7.45	7.46	0.37
2	0.463	0.485	0.491	135.11	146.39	142.21	11.26	12.20	11.85	11.77	0.47
4	0.706	0.807	0.775	213.33	235.93	228.62	17.78	19.66	19.05	18.83	0.96
6	0.671	0.736	0.734	280.14	308.70	301.78	23.34	25.72	25.15	24.74	1.24
8	0.602	0.648	0.654	339.02	372.05	365.61	28.25	31.00	30.47	29.91	1.46
12	0.883	0.954	0.951	436.28	476.21	470.40	36.36	39.68	39.20	38.41	1.79
16	0.843	0.894	0.875	520.58	565.35	556.84	43.38	47.11	46.40	45.63	1.98
20	0.766	0.780	0.772	595.91	641.46	632.03	49.66	53.45	52.67	51.93	2.00
24	0.687	0.685	0.681	663.21	708.46	698.38	55.27	59.04	58.20	57.50	1.98
Receptor volume (ml)	12.75	12.39	12.77								

Table J.2.6. Liquid Crystalline System Composed of Lecithin:Water 40:60 (PTU content = 2,500 μg)

Time (hr)	Absorbance			Amount of PTU (μg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	0.441	0.436	0.418	254.59	251.06	239.46	10.18	10.04	9.58	9.93	0.31
1	0.316	0.319	0.306	403.02	401.76	384.38	16.12	16.07	15.37	15.85	0.42
2	0.413	0.402	0.406	617.46	609.52	595.10	24.70	24.38	23.80	24.29	0.46
4	0.564	0.569	0.631	912.59	908.11	928.90	36.50	36.32	37.16	36.66	0.44
6	0.448	0.433	0.421	1128.70	1114.83	1124.67	45.15	44.59	44.99	44.91	0.29
8	0.318	0.388	0.297	1277.67	1276.68	1264.23	51.11	51.07	50.57	50.92	0.30
12	0.349	0.360	0.325	1454.52	1458.32	1428.74	58.18	58.33	57.15	57.89	0.64
16	0.211	0.246	0.234	1548.38	1572.25	1538.66	61.93	62.89	61.55	62.12	0.69
20	0.140	0.159	0.175	1611.41	1644.20	1620.87	64.46	65.77	64.83	65.02	0.67
24	0.111	0.117	0.118	1636.21	1697.99	1674.22	65.45	67.92	66.97	66.78	1.24
Receptor volume (ml)	12.52	11.49	11.43								

Table J.2.7. Liquid Crystalline System in the Form of Liposomes (PTU content = 1,840 μg)

Time (hr)	Absorbance			Amount of PTU (μg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	0.360	0.381	0.355	207.36	218.31	203.95	11.27	11.86	11.08	11.40	0.41
1	0.253	0.271	0.271	325.15	345.30	332.61	17.67	18.77	18.08	18.17	0.55
2	0.336	0.343	0.345	499.54	522.02	510.70	27.15	28.37	27.75	27.76	0.61
4	0.476	0.453	0.457	749.33	757.53	748.69	40.72	41.17	40.69	40.86	0.27
6	0.350	0.355	0.348	914.60	927.88	914.43	49.71	50.43	49.70	49.95	0.42
8	0.244	0.265	0.249	1027.39	1053.38	1030.40	55.84	57.25	56.00	56.36	0.77
12	0.264	0.280	0.283	1160.49	1193.95	1174.01	63.07	64.89	63.80	63.92	0.91
16	0.211	0.233	0.209	1260.88	1306.02	1271.92	68.53	70.98	69.13	69.55	1.28
20	0.189	0.210	0.185	1352.71	1408.37	1361.06	73.52	76.54	73.97	74.68	1.63
24	0.171	0.219	0.188	1435.27	1517.51	1453.80	78.00	82.47	79.01	79.83	2.34
Receptor volume (ml)	11.52	11.43	11.49								

Table J.2.8. Nonionic Cream Base (PTU content = 1,200 μg)

Time (hr)	Absorbance			Amount of PTU (μg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	*0.526	*0.519	*0.490	135.62	129.60	125.97	11.30	10.80	10.50	10.87	0.40
1	0.700	0.718	0.699	196.81	194.55	188.94	16.40	16.21	15.74	16.12	0.34
2	0.811	0.850	0.828	282.04	283.88	276.34	23.50	23.66	23.03	23.40	0.33
4	*0.552	*0.582	*0.575	401.56	409.01	401.20	33.46	34.08	33.43	33.66	0.37
6	*0.474	*0.493	*0.509	492.78	504.06	500.11	41.06	42.00	41.67	41.58	0.48
8	*0.401	*0.399	*0.441	569.23	579.67	585.12	47.43	48.30	48.76	48.16	0.67
12	*0.538	*0.525	*0.511	685.58	691.83	692.02	57.13	57.65	57.67	57.48	0.31
16	*0.471	*0.450	*0.520	776.81	778.75	797.57	64.73	64.89	66.46	65.36	0.95
20	0.813	0.700	0.806	855.60	844.82	872.74	71.30	70.40	72.73	71.48	1.17
24	0.619	0.572	0.637	912.61	899.39	932.41	76.05	74.95	77.70	76.23	1.38
Receptor volume (ml)	12.77	12.39	12.75								

* after dilution

Table J.2.9. Nonionic Cream Base (PTU content = 2,500 μg)

Time (hr)	Absorbance			Amount of PTU (μg)			% Cumulative Release			Mean	SD
	n_1	n_2	n_3	n_1	n_2	n_3	n_1	n_2	n_3		
0.5	0.352	0.426	0.429	203.33	246.46	246.89	8.13	9.86	9.87	9.29	1.00
1	0.234	0.285	0.277	310.71	378.23	374.30	12.43	15.13	14.97	14.18	1.51
2	0.301	0.352	0.345	466.95	559.80	552.24	18.68	22.39	22.08	21.05	2.06
4	0.415	0.471	0.458	684.77	806.39	790.96	27.39	32.25	31.64	30.43	2.65
6	0.324	0.384	0.368	840.20	992.76	911.95	33.61	39.71	36.48	36.60	3.05
8	0.262	0.318	0.313	966.41	1147.26	1064.95	38.66	45.89	42.60	42.38	3.62
12	0.375	0.469	0.459	1163.65	1395.24	1306.53	46.55	55.81	52.26	51.54	4.67
16	0.326	0.396	0.396	1323.35	1588.65	1500.96	52.93	63.55	60.04	58.84	5.41
20	0.283	0.345	0.399	1461.51	1757.78	1666.81	58.48	70.31	66.67	65.15	6.06
24	0.248	0.309	0.287	1582.85	1910.09	1806.52	63.31	76.40	72.26	70.66	6.69
Receptor volume (ml)	11.52	11.49	11.43								

APPENDIX K

Formula of the Nonionic Cream Base According to the Ministry of Public Health Hospital Formulary

Rx

Stearyl Alcohol	7.00 g
Tween 60	1.00 ml
Tween 80	1.00 ml
Liquid Paraffin	5.00 ml
Glyceryl Monostearate	5.00 g
Spermaceti	3.00 g
Sorbitol Solution	10.00 ml
Preservative qs	
Purified Water to	100.00 g

VITA

Miss Supawadee Archawakom was born on April 28, 1972 in Bangkok, Thailand. She received her Bachelor of Science in Pharmacy Degree from the Faculty of Pharmacy, Mahidol University, Bangkok, Thailand in 1995. After graduation, she worked at Nonthavej Hospital, Bangkok for one year before entering the Master's Degree program in Pharmacy at Chulalongkorn University.