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## APPENDICES

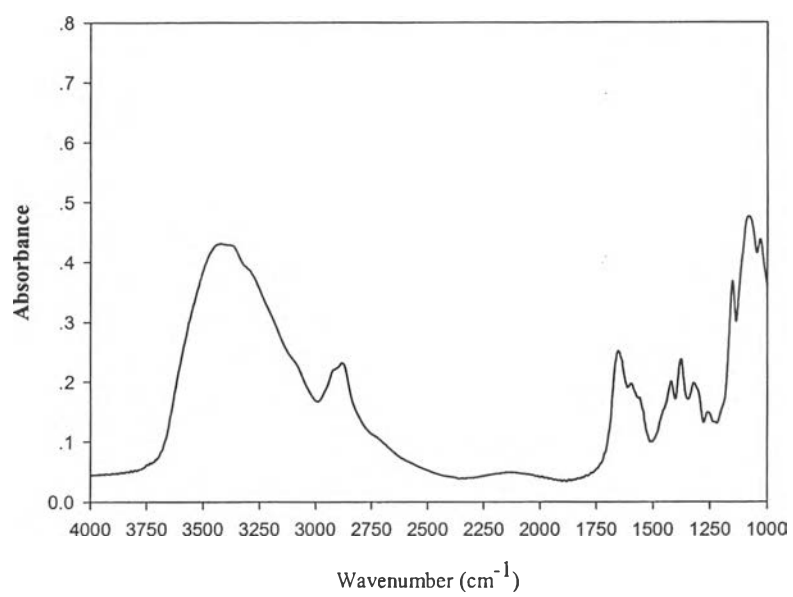
### Appendix A Preparation of Chitosan

**Table A1** Yields of chitin produced from shrimp shell

Chitin Batch no.	Weight of shrimp shells (g)	Weight of chitin (g)	% Yield
1	1000.20	251.70	25.16
2	1000.30	345.12	34.50
3	2000.33	630.89	31.54
4	2000.40	643.33	32.16
5	2000.29	662.40	33.12

**Table A2** Conversion of chitosan from chitin

Chitosan Batch no.	Weight of chitin (g)	Weight of chitosan obtained (g)	Conversion (%w/w)
1	51.44	40.48	78.69
2	58.80	45.49	77.36
3	56.36	43.99	78.05
4	37.95	27.07	71.33
5	57.16	43.55	76.19
6	89.60	69.54	77.61
7	63.72	40.83	64.07
8	71.26	62.55	87.77
9	86.42	74.42	86.11
10	73.54	56.12	76.31
11	106.25	87.44	82.29
12	107.71	99.67	92.53
13	57.47	43.97	76.51
14	105.57	87.91	83.27
15	239.08	191.26	80.00
16	223.26	183.07	82.00

**Appendix B** Characterization of Chitosan**Figure B1** FTIR spectrum of chitosan.

**Table B1** FTIR characteristic absorption bands of chitosan

Frequencies	Assignment and remarks	Reference(s)
1654	C=O stretching	Muzzarelli, 1977;
1592	NH bending	Kurita <i>et al.</i> , 1993;
1321	CN band and CH <sub>2</sub> wagging	Kim <i>et al.</i> , 1996
1081 and 1032	C-O stretching vibration	Kim <i>et al.</i> , 1994

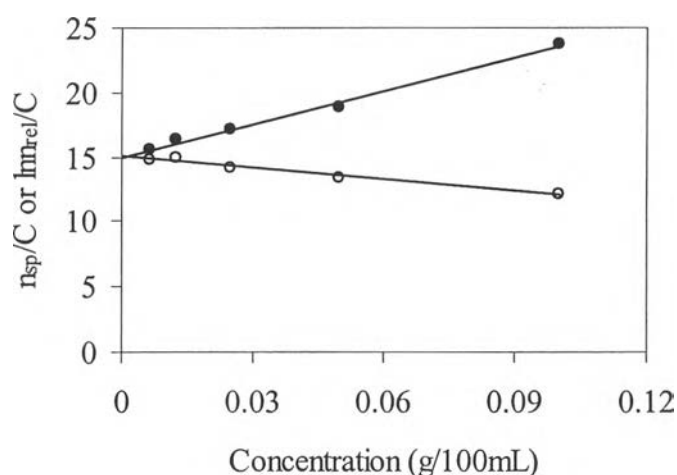
**Appendix C** Determination of Molecular Weight of Chitosan**Table C1** Running time of solvent and chitosan solution

Concentration (g/100 mL)	Time (second)				
	1	2	3	4	Average
0.0000	123.73	124.07	123.67	124.13	123.82
0.0063	135.53	135.63	135.82	135.92	136.51
0.0125	149.77	148.94	149.08	148.99	149.20
0.0250	176.56	176.92	176.78	176.98	176.81
0.0500	241.07	241.34	240.87	241.15	241.11
0.100	416.83	416.72	417.35	417.92	417.21



**Table C2** Data of relative viscosity ( $\eta_{rel}$ ), specific viscosity ( $\eta_{sp}$ ), and reduced viscosity ( $\eta_{red}$ ) of chitosan solution with various concentrations

Concentration (g/100 mL)	$\eta_{rel}$	$\eta_{sp}$	$\eta_{red}$	$\ln[\eta_{rel}]/c$
0.0000				
0.0063	1.0968	0.0968	15.4958	14.7906
0.0125	1.2043	0.2043	16.3450	14.8727
0.0250	1.4272	0.4272	17.0889	14.2292
0.0500	1.9462	0.9462	18.9247	13.3179
0.1000	3.3677	2.3677	23.6771	12.1423



**Figure C1** Plot of reduced viscosity ( $\eta_{sp}/c$ ) and  $\ln((\eta_{rel})/c)$  versus concentration of chitosan solution: • = ( $\eta_{sp}/c$ ) and ◦ =  $\ln((\eta_{rel})/c)$ .

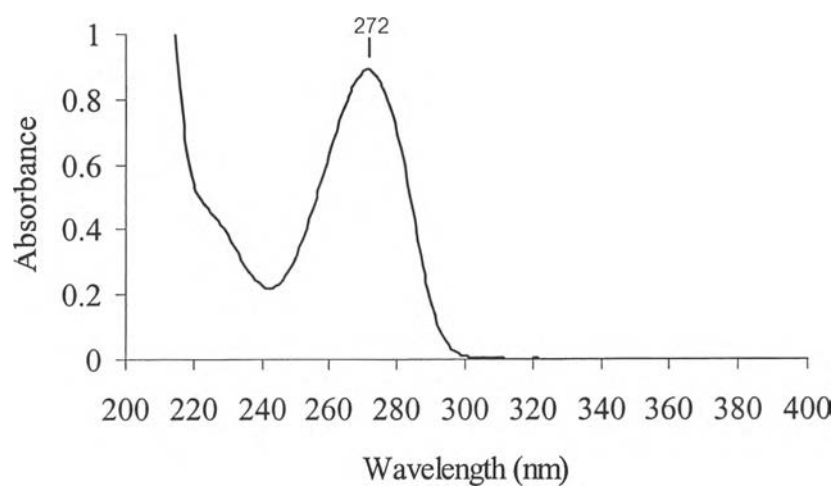
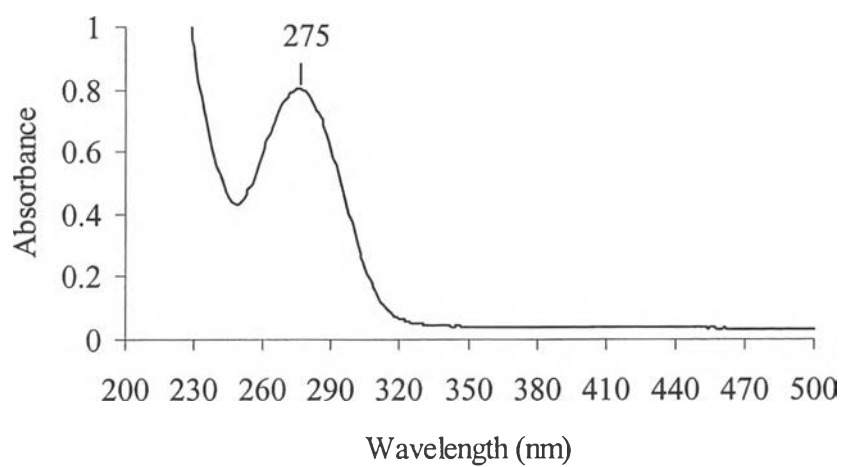
$$[\eta] = kM^a = (8.9 \times 10^{-4})M^{0.71}$$

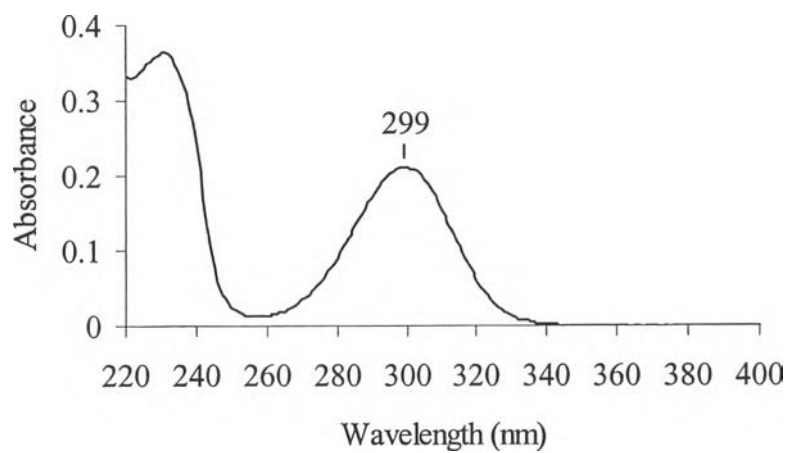
$$M^{0.71} = [\eta] / k = 15.014 \times 10000 / 8.93 = 16812.9899$$

$$\text{alog } M = \log[16812.9899] = 4.2256$$

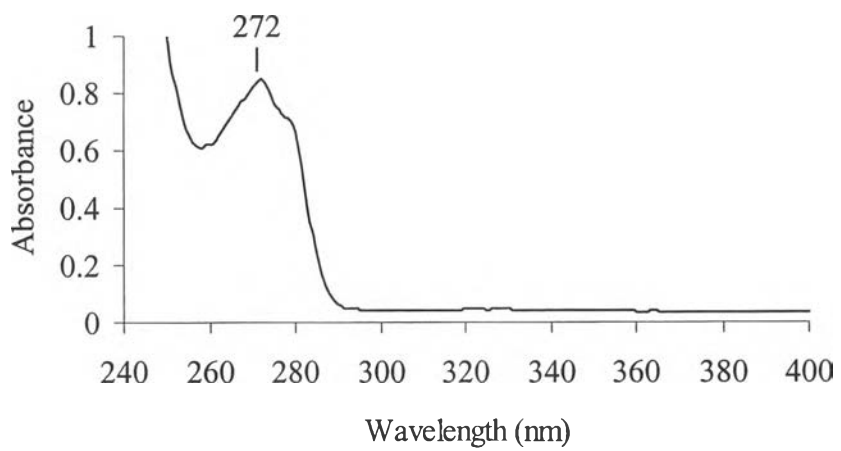
$$\log M = 4.2256 / 0.71 = 5.9516126$$

$$M = 10^{5.9516} = 894566.46 = 8.9 \times 10^5$$

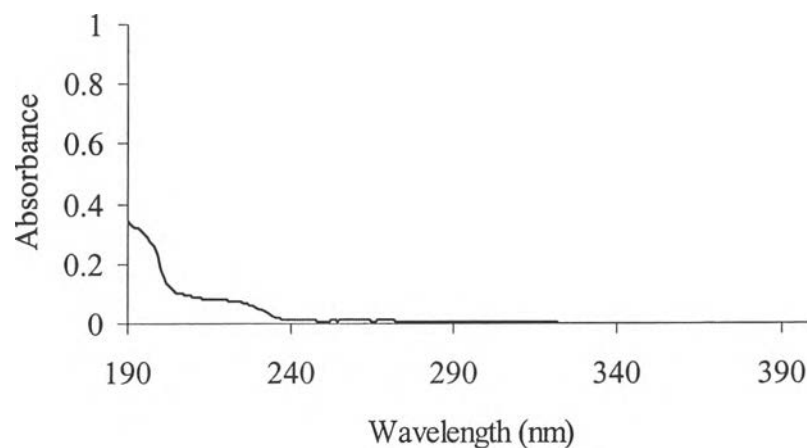
**Appendix D** UV Spectrum of Model Drugs and Glutaraldehyde**Figure D1** UV spectrum of theophylline.**Figure D2** UV spectrum of diclofenac sodium.



**Figure D3** UV spectrum of salicylic acid.



**Figure D4** UV spectrum of amoxicillin trihydrate.



**Figure D5** UV spectrum of glutaraldehyde.

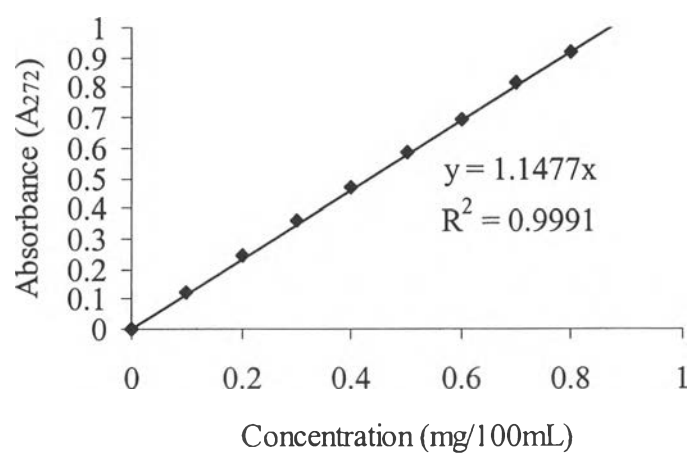
**Table D1** Summary of maximum wavelength ( $\lambda_{\max}$ ) of each type of model drugs and glutaraldehyde

Model drug	$\lambda_{\max}$ (nm)
Theophylline	272
Diclofenac sodium	275
Salicylic acid	299
Amoxicillin trihydrate	272
Glutaraldehyde	No observed

## Appendix E Calibration Curve of Model Drugs

**Table E1** Data of calibration curve of theophylline solution

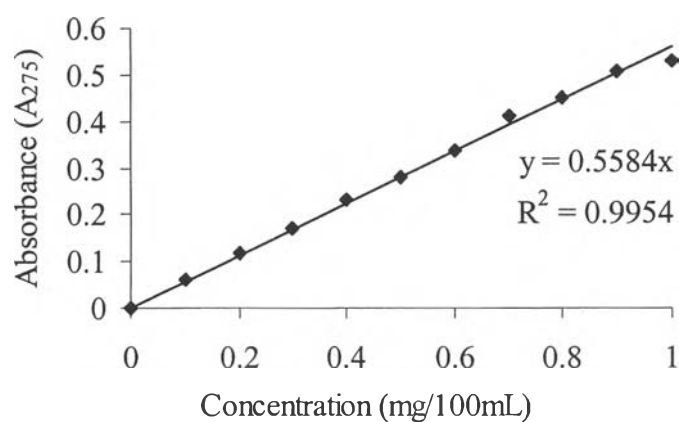
Concentration (mg/100mL)	Absorbance at 272nm ( $A_{272}$ )			Average	Standard deviation
	X1	X2	X3		
0.0	0.0000	0.0000	0.0000	0.0000	0.0000
0.1	0.1192	0.1192	0.1192	0.1192	0.0000
0.2	0.2414	0.2418	0.2415	0.2416	0.0002
0.3	0.3597	0.3600	0.3603	0.3600	0.0003
0.4	0.4702	0.4704	0.4705	0.4704	0.0002
0.5	0.5831	0.5832	0.5828	0.5830	0.0002
0.6	0.6938	0.6935	0.6936	0.6936	0.0002
0.7	0.8161	0.8160	0.8159	0.8160	0.0001
0.8	0.9152	0.9152	0.9157	0.9154	0.0003



**Figure E1** Calibration curve of theophylline solution.

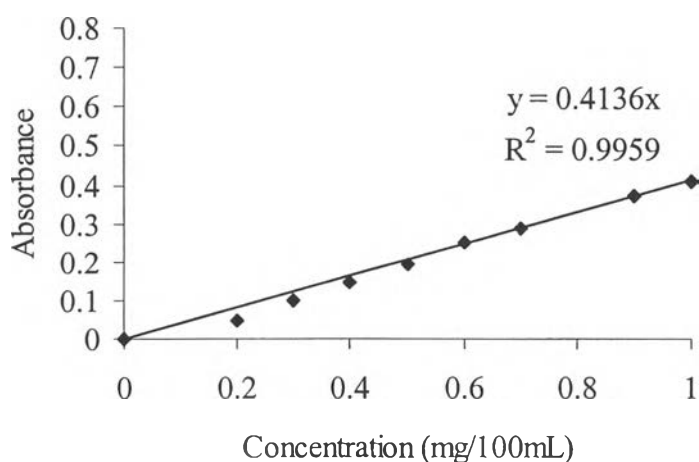
**Table E2** Data of calibration curve of diclofenac sodium solution

Concentration (mg/100mL)	Absorbance at 275nm ( $A_{275}$ )			Average	Standard deviation
	X1	X2	X3		
0.0	0.0000	0.0000	0.0000	0.0000	0.0000
0.1	0.0626	0.0620	0.0621	0.0622	0.0003
0.2	0.1196	0.1196	0.1197	0.1196	0.0001
0.3	0.1712	0.1713	0.1714	0.1713	0.0001
0.4	0.2316	0.2316	0.2318	0.2317	0.0001
0.5	0.2787	0.2789	0.2788	0.2788	0.0001
0.6	0.3374	0.3376	0.3375	0.3375	0.0001
0.7	0.4117	0.4114	0.4117	0.4116	0.0002
0.8	0.4489	0.4490	0.4490	0.4490	0.0001
0.9	0.5081	0.5083	0.5080	0.5081	0.0002
1.0	0.5294	0.5294	0.5290	0.5293	0.0002

**Figure E2** Calibration curve of diclofenac sodium solution.

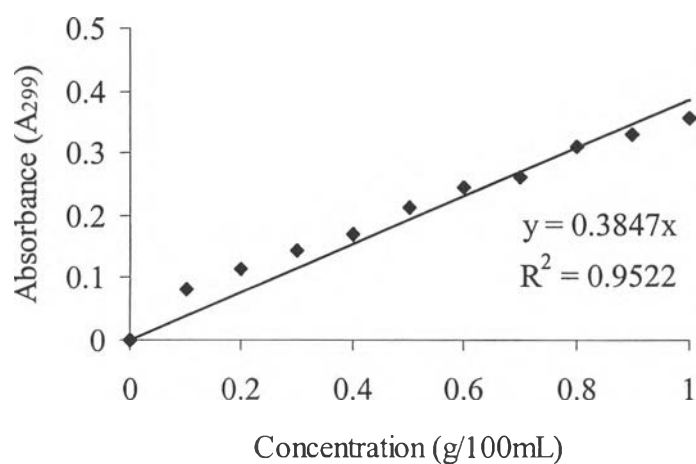
**Table E3** Data of calibration curve of amoxicillin trihydrate solution

Concentration (mg/100mL)	Absorbance at 272nm ( $A_{272}$ )			Average	Standard deviation
	X1	X2	X3		
0.0	0.0000	0.0000	0.0000	0.0000	0.0000
0.1	0.0001	0.0005	0.0003	0.0003	0.0002
0.2	0.0450	0.0454	0.0455	0.0453	0.0003
0.3	0.0986	0.0984	0.0984	0.0985	0.0001
0.4	0.1462	0.1458	0.1457	0.1459	0.0003
0.5	0.1920	0.1922	0.1922	0.1921	0.0001
0.6	0.2492	0.2490	0.2493	0.2492	0.0002
0.7	0.2878	0.2880	0.2880	0.2879	0.0001
0.8	0.2922	0.2922	0.2921	0.2922	0.0001
0.9	0.3738	0.3737	0.3735	0.3737	0.0002
1.0	0.4085	0.4082	0.4083	0.4083	0.0002

**Figure E3** Calibration curve of amoxicillin trihydrate solution.

**Table E4** Data of calibration curve of salicylic acid solution

Concentration (mg/100mL)	Absorbance at 299nm ( $A_{299}$ )			Average	Standard deviation
	X1	X2	X3		
0.0	0.0000	0.0000	0.0000	0.0000	0.0000
0.1	0.0814	0.0816	0.0816	0.0815	0.0001
0.2	0.1127	0.1128	0.1130	0.1128	0.0002
0.3	0.1423	0.1428	0.1427	0.1426	0.0003
0.4	0.1695	0.1697	0.1697	0.1696	0.0001
0.5	0.2126	0.2134	0.2129	0.2130	0.0004
0.6	0.2446	0.2454	0.2454	0.2451	0.0005
0.7	0.2628	0.2626	0.2626	0.2627	0.0001
0.8	0.3100	0.3102	0.3102	0.3101	0.0001
0.9	0.3281	0.3287	0.3287	0.3285	0.0003
1.0	0.3573	0.3570	0.3573	0.3572	0.0002

**Figure E4** Calibration curve of salicylic acid solution.



## Appendix F Data of Drug Release

**Table F1** Release of theophylline from crosslinked chitosan film at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.00
0.5	32.92	32.84	32.95	32.91	0.053
1.0	70.01	70.30	70.45	70.25	0.221
1.5	75.45	75.37	75.26	75.36	0.096
2.0	75.80	75.61	75.99	75.80	0.192
2.5	75.79	75.90	76.02	75.90	0.113
3.0	75.98	75.80	75.62	75.79	0.183
3.5	76.01	75.78	75.79	75.85	0.111
4.0	75.94	76.16	76.10	76.07	0.116
4.5	76.06	75.96	76.12	76.04	0.059
5.0	76.12	76.13	76.29	76.18	0.090
7.5	76.23	76.13	76.43	76.26	0.122
10.0	76.53	76.41	76.30	76.40	0.113
12.5	76.81	76.53	77.02	76.79	0.245
15.0	77.44	77.11	77.54	77.36	0.227
20.0	77.55	77.34	77.23	77.38	0.160
25.0	78.06	77.37	77.54	77.66	0.362
30.0	77.65	77.70	77.82	77.69	0.149
40.0	77.80	77.60	77.91	77.78	0.160
50.0	78.19	78.05	78.24	78.16	0.099
60.0	78.78	78.41	79.82	79.00	0.723

**Table F2** Release of theophylline from the blend films with 80% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0	0.00
0.5	66.72	66.83	67.00	66.85	0.141
1.0	77.54	77.34	77.72	77.53	0.192
1.5	77.37	77.35	74.76	76.49	1.504
2.0	77.54	77.84	77.63	77.67	0.152
2.5	77.68	77.35	77.37	77.47	0.186
3.0	77.63	77.40	77.20	77.41	0.217
3.5	77.45	77.34	77.18	77.32	0.139
4.0	77.58	77.44	77.73	77.58	0.148
4.5	77.60	77.72	77.63	77.64	0.070
5.0	77.75	77.53	77.35	77.54	0.200
7.5	77.87	77.68	77.93	77.83	0.128
10.0	78.10	77.81	78.01	77.97	0.152
12.5	78.29	77.98	78.19	78.16	0.159
15.0	78.40	78.15	78.22	78.26	0.126
20.0	78.38	78.20	78.33	78.30	0.090
25.0	78.82	78.37	78.94	78.69	0.303
30.0	79.06	78.63	79.11	78.93	0.267
40.0	79.29	79.51	78.38	79.06	0.600
50.0	79.48	79.32	79.65	79.48	0.165
60.0	81.93	81.19	82.04	81.72	0.465

**Table F3** Release of theophylline from the blend films with 60% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0	0.00
0.5	62.05	62.07	62.16	62.10	0.056
1.0	63.22	63.06	63.10	63.13	0.082
1.5	69.97	71.76	71.41	71.05	0.954
2.0	69.44	73.38	72.25	71.72	2.043
2.5	73.21	76.88	73.16	74.41	2.141
3.0	73.38	77.60	74.88	75.29	2.139
3.5	74.17	75.83	74.94	74.98	0.837
4.0	74.56	76.64	76.36	75.85	1.125
4.5	75.61	76.01	75.96	75.86	0.218
5.0	75.89	76.13	75.58	75.87	0.280
7.5	75.86	76.34	75.77	75.99	0.310
10.0	75.78	76.29	75.96	76.01	0.264
12.5	76.34	76.01	75.65	76.00	0.349
15.0	75.91	76.40	75.84	76.05	0.304
20.0	76.24	76.48	76.03	76.25	0.227
25.0	76.47	76.50	76.31	76.43	0.102
30.0	76.99	76.61	76.71	76.77	0.198
40.0	77.15	76.90	76.78	76.94	0.186
50.0	76.99	77.15	76.88	77.01	0.132
60.0	77.18	78.16	77.55	77.63	0.493

**Table F4** Release of theophylline from the blend films with 50% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.00
0.5	54.39	58.31	53.18	55.29	2.679
1.0	64.56	61.20	59.35	61.71	2.642
1.5	68.28	64.74	62.93	65.31	2.721
2.0	71.20	67.47	65.44	68.04	2.925
2.5	71.78	68.99	67.14	69.30	2.334
3.0	73.56	69.84	69.62	71.01	2.211
3.5	74.11	73.03	70.61	72.59	1.794
4.0	73.14	73.24	71.71	72.70	0.857
4.5	72.46	73.05	72.77	72.76	0.296
5.0	72.55	72.41	72.04	72.33	0.261
7.5	72.67	72.88	72.81	72.78	0.106
10.0	73.00	72.75	72.46	72.74	0.271
12.5	73.03	72.63	71.60	72.42	0.737
15.0	72.96	72.58	71.73	72.42	0.517
20.0	73.02	72.75	72.11	72.63	0.381
25.0	75.51	75.39	76.52	75.80	0.508
30.0	73.10	72.25	72.46	72.60	0.363
40.0	73.28	77.70	76.17	75.72	1.835
50.0	74.88	76.90	76.45	76.08	0.866
60.0	77.29	77.86	78.78	77.98	0.617

**Table F5** Release of theophylline from the blend films with 40% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.00
0.5	57.87	56.03	59.35	57.75	1.668
1.0	62.00	60.22	55.22	59.15	3.515
1.5	67.81	69.09	70.63	69.18	1.413
2.0	69.74	68.89	70.84	69.82	0.978
2.5	72.42	69.69	71.55	71.22	1.398
3.0	72.91	72.44	72.13	72.49	0.395
3.5	73.28	72.96	72.44	72.89	0.423
4.0	73.16	72.95	72.49	72.86	0.339
4.5	73.45	73.10	73.36	73.31	0.181
5.0	73.56	73.21	72.93	73.23	0.314
7.5	73.35	74.17	72.67	73.39	0.750
10.0	73.17	73.38	73.76	73.44	0.300
12.5	73.38	74.10	73.22	73.57	0.464
15.0	74.17	74.67	73.94	74.26	0.375
20.0	73.68	74.06	74.03	73.92	0.212
25.0	73.76	73.52	74.58	73.96	0.557
30.0	74.92	75.39	73.10	74.47	1.205
40.0	75.16	75.07	74.53	74.92	0.340
50.0	75.33	74.86	74.74	74.98	0.313
60.0	75.39	75.86	74.17	75.14	0.872

**Table F6** Release of theophylline from chitosan films at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0	0.00
0.5	34.09	32.67	33.21	33.32	0.712
1.0	37.61	39.03	37.57	38.07	0.835
1.5	53.25	49.05	50.62	50.98	2.122
2.0	64.77	56.83	61.22	60.94	3.980
2.5	68.89	65.49	67.20	67.19	1.699
3.0	69.95	66.45	69.27	68.55	1.857
3.5	69.79	68.87	69.93	69.53	0.578
4.0	69.91	69.55	70.70	70.05	0.588
4.5	70.28	69.72	70.75	70.25	70.25
5.0	70.59	70.37	69.79	70.25	0.413
7.5	70.66	70.84	70.11	70.54	0.382
10.0	71.13	71.26	69.98	70.79	0.702
12.5	71.36	71.06	70.11	70.84	0.656
15.0	71.13	70.89	71.08	71.03	0.128
20.0	71.45	69.97	70.14	70.52	0.810
25.0	71.71	71.24	70.68	71.21	0.515
30.0	71.36	71.81	69.86	71.01	1.021
40.0	71.80	70.68	71.80	71.42	0.644
50.0	71.22	70.23	71.08	70.84	0.538
60.0	71.76	71.81	71.27	71.62	0.298

**Table F7** Release of theophylline from the blend films with 80% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0	0.00
0.5	37.64	40.08	41.82	39.85	2.101
1.0	60.47	63.26	64.83	62.85	2.207
1.5	64.83	69.36	67.44	67.21	2.274
2.0	68.14	69.18	67.79	68.37	0.726
2.5	65.87	68.66	71.27	68.60	2.702
3.0	67.79	69.01	69.53	68.78	0.894
3.5	68.14	69.70	69.93	69.26	0.977
4.0	68.48	69.01	69.01	68.83	0.302
4.5	69.53	67.96	69.18	68.89	0.824
5.0	69.39	68.94	69.32	69.22	0.244
7.5	68.48	69.01	69.53	69.01	0.523
10.0	69.18	69.01	69.53	69.24	0.266
12.5	71.62	67.79	68.66	69.36	2.010
15.0	69.53	67.61	72.14	69.76	2.274
20.0	70.23	66.74	73.19	70.05	3.227
25.0	73.19	68.14	69.18	70.17	2.668
30.0	69.53	67.96	73.19	70.23	2.683
40.0	70.92	67.79	74.24	70.98	3.224
50.0	72.49	72.14	70.05	71.56	1.319
60.0	73.19	67.96	73.71	71.62	3.180

**Table F8** Release of theophylline from the blend films with 60% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.00
0.5	52.28	54.89	60.99	56.05	4.471
1.0	65.00	64.48	67.96	65.81	1.880
1.5	67.96	68.14	64.83	66.97	1.863
2.0	65.87	67.96	69.70	67.85	1.920
2.5	69.53	67.79	67.44	68.25	1.120
3.0	65.70	69.18	70.23	68.37	2.372
3.5	67.96	68.14	69.18	68.43	0.660
4.0	67.44	69.18	69.36	65.96	1.060
4.5	66.74	69.01	70.58	68.78	1.927
5.0	68.14	67.79	67.44	67.79	0.349
7.5	69.70	70.58	66.39	68.89	2.207
10.0	71.97	69.18	66.74	69.30	2.616
12.5	68.66	67.79	71.62	69.36	1.641
15.0	66.74	69.53	73.02	69.76	3.143
20.0	72.14	67.61	69.53	69.76	2.274
25.0	72.49	66.74	70.23	69.82	2.897
30.0	68.66	67.61	73.71	70.00	3.262
40.0	69.93	69.27	71.85	70.35	1.339
50.0	69.18	68.14	73.19	70.17	2.668
60.0	74.24	67.79	70.92	70.98	3.224



**Table F9** Release of theophylline from the blend films with 50% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	54.02	57.33	57.72	56.36	2.031
1.0	56.01	59.84	56.37	57.41	2.116
1.5	57.61	58.94	60.49	59.01	1.439
2.0	59.11	61.50	61.62	60.74	1.415
2.5	59.48	63.57	63.87	62.30	2.454
3.0	57.61	65.54	62.70	61.95	4.017
3.5	60.10	63.47	61.92	61.83	0.922
4.0	58.88	59.86	58.94	59.23	0.549
4.5	60.28	64.88	65.03	63.40	2.703
5.0	62.51	64.48	64.84	63.94	1.256
7.5	61.53	61.95	65.98	63.15	2.454
10.0	61.92	65.71	65.87	64.50	2.240
12.5	66.43	66.59	66.69	66.57	0.132
15.0	62.21	67.33	67.47	65.67	2.999
20.0	63.71	66.15	63.83	64.56	1.375
25.0	63.52	67.49	67.51	66.17	2.299
30.0	65.23	67.44	67.70	66.79	1.360
40.0	67.20	67.91	66.48	67.20	0.714
50.0	67.98	65.57	67.00	66.85	1.209
60.0	68.45	68.19	69.72	68.79	0.820

**Table F10** Release of theophylline from the blend films with 40% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.00
0.5	53.74	53.86	53.86	53.82	0.070
1.0	61.24	61.20	61.48	61.31	0.152
1.5	63.17	67.65	67.56	66.13	2.561
2.0	67.25	64.39	69.23	66.96	2.435
2.5	64.02	64.18	68.75	65.65	2.682
3.0	64.60	64.81	69.08	66.16	2.527
3.5	68.61	68.75	69.23	68.86	0.329
4.0	68.75	68.82	68.61	68.72	0.106
4.5	68.94	69.13	69.23	69.10	0.150
5.0	68.89	69.08	69.11	69.03	0.122
7.5	67.77	67.91	66.41	67.36	0.828
10.0	66.76	69.44	67.87	68.03	1.348
12.5	69.93	66.48	67.74	68.05	1.746
15.0	66.39	69.37	69.97	68.58	1.915
20.0	67.04	67.20	71.85	68.69	2.733
25.0	67.46	70.84	69.29	69.19	1.692
30.0	65.45	69.41	71.34	68.73	3.002
40.0	67.00	67.09	72.61	68.90	3.215
50.0	68.71	68.89	70.12	69.24	0.770
60.0	71.80	69.67	69.23	70.23	1.371

**Table F11** Release of theophylline from chitosan films at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	46.13	44.51	42.82	44.48	1.656
1.0	57.85	58.38	59.02	58.42	0.585
1.5	61.72	61.82	61.20	61.58	0.335
2.0	64.29	64.44	64.67	64.47	0.193
2.5	65.05	65.40	65.64	65.37	0.298
3.0	65.40	65.63	65.24	65.42	0.193
3.5	65.30	65.92	64.65	65.29	0.636
4.0	65.37	65.96	66.57	65.96	0.601
4.5	66.03	66.43	66.18	66.21	0.202
5.0	65.61	65.42	66.01	65.68	0.302
7.5	66.01	66.05	66.41	66.16	0.222
10.0	66.59	66.20	66.79	66.53	0.300
12.5	67.18	66.59	66.38	66.71	0.416
15.0	67.53	67.79	68.00	67.77	0.236
20.0	67.75	67.86	68.17	67.93	0.218
25.0	67.53	67.77	67.94	67.75	0.210
30.0	67.82	67.53	67.94	67.76	0.215
40.0	67.51	67.96	66.48	67.32	0.759
50.0	67.86	67.91	67.70	67.82	0.109
60.0	67.53	67.96	67.49	67.66	0.262

**Table F12** Release of theophylline from the blend films with 80% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	50.80	48.58	52.47	50.62	1.949
1.0	58.29	59.86	61.78	59.98	1.746
1.5	59.79	61.11	63.80	61.57	2.042
2.0	65.37	63.64	66.03	65.01	1.233
2.5	66.22	66.18	66.48	66.29	0.162
3.0	67.53	66.41	66.74	66.89	0.573
3.5	66.78	67.18	67.93	67.29	0.584
4.0	67.04	67.37	67.74	67.38	0.349
4.5	67.35	67.93	67.74	67.67	0.293
5.0	67.75	67.23	67.65	67.54	0.277
7.5	67.77	67.28	67.79	67.61	0.287
10.0	68.08	68.15	67.60	67.94	0.304
12.5	68.26	67.72	66.93	67.64	0.666
15.0	67.86	68.17	67.81	67.94	0.198
20.0	67.58	67.91	67.20	67.56	0.358
25.0	67.75	67.82	66.93	67.50	0.493
30.0	67.77	67.87	67.96	67.87	0.096
40.0	67.91	67.70	67.70	67.77	0.121
50.0	67.98	67.47	68.35	67.93	0.438
60.0	68.17	68.12	67.60	67.96	0.318

**Table F13** Release of theophylline from the blend films with 60% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	48.60	49.02	50.15	49.26	0.802
1.0	49.05	50.45	50.76	50.09	0.909
1.5	51.16	52.24	52.02	51.81	0.570
2.0	52.57	53.48	54.37	53.48	0.897
2.5	56.37	58.01	58.90	57.76	1.280
3.0	58.71	60.26	60.43	59.80	0.950
3.5	59.23	60.42	60.77	60.14	0.804
4.0	59.61	60.75	60.80	60.39	0.670
4.5	61.17	60.89	61.51	61.19	0.314
5.0	60.99	60.63	62.30	61.31	0.879
7.5	61.15	60.77	60.97	60.96	0.192
10.0	60.56	60.85	60.99	60.80	0.222
12.5	60.80	60.77	61.13	60.90	0.202
15.0	60.83	60.38	60.80	60.67	0.252
20.0	61.08	59.41	60.56	60.35	0.856
25.0	61.20	60.78	60.56	60.85	0.327
30.0	60.99	61.27	60.40	60.89	0.445
40.0	60.78	60.90	60.94	60.88	0.082
50.0	60.75	60.77	60.71	60.74	0.027
60.0	60.97	60.71	60.97	60.89	0.151

**Table F14** Release of theophylline from the blend films with 50% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	48.55	50.22	49.05	49.28	0.858
1.0	53.79	51.44	51.69	52.31	1.294
1.5	54.54	55.50	55.62	55.22	0.592
2.0	56.29	56.76	57.14	56.73	0.428
2.5	58.81	59.18	58.94	58.98	0.186
3.0	59.27	59.68	59.23	59.39	0.252
3.5	60.63	60.21	59.56	60.13	0.536
4.0	60.73	60.63	60.26	60.54	0.247
4.5	60.87	60.78	60.59	60.75	0.143
5.0	61.46	61.15	61.18	61.26	0.172
7.5	62.05	61.83	61.36	61.75	0.356
10.0	62.49	62.70	61.37	62.19	0.712
12.5	62.56	62.89	62.51	62.65	0.208
15.0	62.86	63.22	62.91	63.00	0.198
20.0	63.31	62.89	62.77	62.99	0.283
25.0	63.74	63.47	62.35	63.19	0.738
30.0	64.08	63.45	64.04	63.86	0.353
40.0	64.29	63.17	64.67	64.04	0.779
50.0	63.38	63.95	64.72	64.02	0.673
60.0	64.37	64.26	64.20	64.28	0.089

**Table F15** Release of theophylline from the blend films with 40% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	42.80	44.87	45.53	44.40	1.427
1.0	48.46	46.53	48.51	47.83	1.132
1.5	49.51	49.77	50.05	49.77	0.270
2.0	51.98	51.44	50.73	51.38	0.629
2.5	54.47	53.83	52.16	53.49	1.196
3.0	55.01	55.53	53.31	54.62	1.163
3.5	55.40	55.85	55.15	55.47	0.354
4.0	56.34	56.60	57.31	56.75	0.505
4.5	57.80	58.94	58.76	58.50	0.610
5.0	59.51	60.26	59.68	59.82	0.392
7.5	59.68	59.51	60.78	59.99	0.690
10.0	60.26	60.42	61.01	60.56	0.395
12.5	59.98	60.70	60.99	60.56	0.520
15.0	60.80	60.99	61.20	61.00	0.200
20.0	59.89	60.99	62.40	61.10	1.258
25.0	60.80	61.20	61.90	61.30	0.556
30.0	61.20	61.13	59.93	60.75	0.715
40.0	60.28	61.34	62.21	61.28	0.969
50.0	61.20	62.33	62.16	61.90	0.610
60.0	63.99	63.57	62.54	63.37	0.744

**Table F16** Release of amoxicillin from chitosan films at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	10.40	11.41	12.33	11.38	0.968
1.0	13.97	15.14	16.68	15.26	1.359
1.5	15.81	17.21	17.17	16.73	0.796
2.0	16.83	18.62	17.26	17.57	0.933
2.5	18.33	18.76	16.73	17.94	1.069
3.0	18.47	18.81	18.28	18.52	0.269
3.5	18.67	18.23	19.29	18.73	0.535
4.0	19.44	19.15	20.94	19.84	0.960
4.5	20.41	19.58	23.60	21.20	2.120
5.0	21.91	20.36	22.97	21.74	1.313
7.5	21.03	20.60	22.68	21.44	1.097
10.0	22.10	23.60	19.87	21.86	1.873
12.5	24.76	22.82	20.45	22.68	2.156
15.0	24.42	24.13	22.29	23.61	1.154
20.0	24.47	23.50	22.97	23.65	0.760
25.0	25.92	24.76	24.08	24.92	0.929
30.0	26.35	26.89	24.81	26.02	1.080
40.0	26.60	25.92	27.80	26.77	0.955
50.0	28.43	27.18	28.63	28.08	0.788
60.0	29.93	31.43	29.50	30.29	1.015



**Table F17** Release of amoxicillin from the blend films with 80% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	22.34	23.45	21.91	22.57	0.798
1.0	23.79	23.55	25.24	24.19	0.915
1.5	24.23	24.71	25.63	24.85	0.712
2.0	25.77	27.47	27.80	27.01	1.088
2.5	27.42	25.87	28.29	27.19	1.225
3.0	27.80	25.19	27.18	26.72	1.363
3.5	28.97	27.85	29.55	28.79	0.860
4.0	28.53	27.95	29.06	28.51	0.556
4.5	29.06	28.14	28.68	28.63	0.461
5.0	28.97	28.38	30.22	29.19	0.939
7.5	29.01	27.85	29.74	28.87	0.951
10.0	29.61	28.34	30.13	29.36	0.921
12.5	29.26	30.71	29.93	29.96	0.726
15.0	30.17	29.98	29.55	29.90	0.322
20.0	32.16	29.69	28.97	30.27	1.673
25.0	31.58	31.33	30.22	31.04	0.722
30.0	33.08	31.67	34.86	33.20	1.600
40.0	33.51	36.61	35.44	35.19	1.563
50.0	34.91	38.15	37.14	36.73	1.657
60.0	35.30	38.73	37.43	37.15	1.733

**Table F18** Release of amoxicillin from the blend films with 60% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	10.20	9.04	9.28	9.51	0.612
1.0	11.22	10.59	10.01	10.61	0.607
1.5	11.94	10.11	12.96	11.67	1.446
2.0	12.72	10.83	12.14	11.90	0.966
2.5	11.94	13.20	11.46	12.20	0.899
3.0	17.21	15.04	14.36	15.54	1.491
3.5	18.23	16.05	15.81	16.70	1.332
4.0	18.67	17.07	15.43	17.05	1.620
4.5	18.96	17.99	16.49	17.81	1.243
5.0	19.39	18.38	19.20	18.99	0.539
7.5	20.70	18.52	18.81	19.34	1.182
10.0	19.78	21.28	20.07	20.37	0.795
12.5	20.21	21.86	19.29	20.45	1.298
15.0	22.20	22.34	20.45	21.66	1.049
20.0	20.94	22.00	23.31	22.08	1.187
25.0	19.92	24.08	22.97	22.32	2.153
30.0	20.89	23.55	23.31	22.58	1.471
40.0	24.42	23.94	23.55	23.97	0.436
50.0	25.24	25.82	24.42	25.16	0.705
60.0	26.89	27.22	25.53	26.55	0.896

**Table F19** Release of amoxicillin from the blend films with 50% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	8.90	7.98	9.33	8.74	0.691
1.0	9.57	10.69	8.95	9.74	0.882
1.5	10.88	12.81	9.62	11.11	1.608
2.0	11.12	13.93	14.41	13.15	1.775
2.5	13.30	14.41	14.56	14.09	0.688
3.0	13.93	14.51	16.10	14.85	1.127
3.5	15.57	15.23	17.02	15.94	0.950
4.0	16.78	14.89	17.65	16.44	1.409
4.5	15.04	17.26	17.89	16.73	1.499
5.0	16.88	18.23	16.83	17.31	0.796
7.5	16.05	17.26	17.99	17.10	0.977
10.0	17.02	18.81	15.76	17.20	1.531
12.5	18.09	19.05	16.92	18.02	1.065
15.0	17.89	18.81	16.05	17.59	1.403
20.0	18.96	16.97	19.92	18.62	1.504
25.0	19.87	20.89	20.45	20.41	0.509
30.0	20.94	20.07	20.55	20.52	0.436
40.0	19.92	21.86	21.42	21.07	1.015
50.0	22.05	22.15	20.41	21.53	0.978
60.0	22.24	20.89	22.78	21.97	0.972

**Table F20** Release of amoxicillin from the blend films with 40% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	3.97	3.63	4.41	4.00	0.393
1.0	6.87	5.90	8.03	6.93	1.065
1.5	8.56	6.38	8.27	7.74	1.182
2.0	8.85	9.53	10.15	9.51	0.653
2.5	10.69	8.61	11.99	10.43	1.707
3.0	11.94	11.17	11.22	11.44	0.433
3.5	11.41	12.77	11.65	11.94	0.722
4.0	13.39	12.04	11.70	12.38	0.896
4.5	13.30	11.41	11.41	12.04	1.089
5.0	12.38	12.96	12.04	12.46	0.465
7.5	13.88	14.46	12.23	13.52	1.154
10.0	15.09	14.51	13.59	14.39	0.756
12.5	16.10	15.52	14.51	15.38	0.808
15.0	15.67	16.20	14.46	15.44	0.892
20.0	16.01	15.57	14.94	15.51	0.535
25.0	16.34	15.72	16.49	16.18	0.411
30.0	16.92	15.62	17.21	16.59	0.850
40.0	18.57	19.05	20.89	19.50	1.225
50.0	19.20	20.41	20.94	20.18	0.892
60.0	20.55	21.13	20.26	20.65	0.443

**Table F21** Release of amoxicillin from chitosan films at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	7.25	7.30	7.21	7.25	0.048
1.0	8.80	8.80	9.14	8.91	0.195
1.5	11.70	12.23	12.09	12.01	0.275
2.0	14.41	15.04	13.93	14.46	0.558
2.5	16.34	16.05	16.44	16.28	0.201
3.0	17.26	16.78	16.54	16.86	0.369
3.5	18.62	17.02	16.34	17.33	1.167
4.0	19.63	18.81	19.20	19.21	0.411
4.5	20.41	19.20	19.39	19.66	0.649
5.0	19.92	19.58	18.86	19.46	0.544
7.5	21.32	22.15	20.41	21.29	0.871
10.0	21.81	22.34	22.97	22.37	0.581
12.5	22.29	23.11	23.31	22.90	0.539
15.0	22.82	23.60	24.23	23.55	0.702
20.0	23.65	23.79	24.85	24.10	0.660
25.0	23.89	24.08	25.15	24.37	0.677
30.0	24.66	25.34	26.45	25.48	0.903
40.0	25.82	25.73	25.97	25.84	0.122
50.0	26.11	25.58	27.27	26.32	0.865
60.0	26.64	25.24	27.88	26.59	1.319

**Table F22** Release of amoxicillin from the blend films with 80% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	11.41	11.85	10.20	11.15	0.852
1.0	14.80	13.88	11.94	13.54	1.456
1.5	15.18	15.57	13.88	14.88	0.887
2.0	16.54	17.50	15.91	16.65	0.804
2.5	17.75	18.23	16.68	17.55	0.792
3.0	18.58	18.96	18.13	18.56	0.412
3.5	18.81	18.67	19.25	18.91	0.302
4.0	21.73	20.31	23.21	21.75	1.451
4.5	23.34	20.45	23.11	22.30	1.605
5.0	24.52	23.31	22.82	23.55	0.872
7.5	24.94	23.79	23.31	24.01	0.836
10.0	26.60	25.34	24.37	25.44	1.115
12.5	28.05	28.63	25.77	27.48	1.508
15.0	25.77	26.21	29.55	27.18	2.063
20.0	29.01	25.77	27.90	27.56	1.646
25.0	30.46	28.09	25.29	27.95	2.590
30.0	31.91	27.13	28.19	29.08	2.512
40.0	32.40	30.13	28.97	30.50	1.746
50.0	32.88	30.66	30.03	31.19	1.499
60.0	31.77	34.19	35.88	33.95	2.066

**Table F23** Release of amoxicillin from the blend films with 60% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	3.05	2.78	2.83	2.89	0.141
1.0	3.59	3.15	3.33	3.36	0.222
1.5	9.04	6.19	9.04	8.09	1.647
2.0	9.67	7.53	8.99	8.73	1.096
2.5	8.43	8.80	8.37	8.53	0.235
3.0	6.19	9.06	10.20	8.48	2.068
3.5	11.09	9.77	11.65	10.84	0.968
4.0	14.94	10.25	10.20	11.80	2.722
4.5	12.28	12.33	13.49	12.70	0.684
5.0	11.20	13.27	11.65	12.04	1.085
7.5	11.28	14.41	17.12	14.27	2.920
10.0	14.41	14.89	14.46	14.59	0.266
12.5	14.22	16.49	14.99	15.23	1.155
15.0	17.41	18.38	18.86	18.21	0.739
20.0	19.87	19.44	20.79	20.04	0.691
25.0	20.84	21.76	20.85	21.15	0.528
30.0	19.44	22.65	21.91	21.33	1.679
40.0	23.11	22.05	20.89	22.02	1.113
50.0	22.65	24.18	23.60	23.47	0.773
60.0	23.36	24.71	26.50	24.85	1.577

**Table F24** Release of amoxicillin from the blend films with 50% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	8.91	7.07	8.56	8.18	0.978
1.0	9.14	8.08	9.62	8.95	0.792
1.5	10.15	8.99	11.12	10.09	1.065
2.0	10.53	11.85	11.36	11.25	0.669
2.5	10.54	12.33	11.41	11.43	0.895
3.0	11.64	11.36	10.93	11.31	0.358
3.5	12.86	12.14	11.80	12.27	0.544
4.0	11.32	13.30	12.38	12.33	0.992
4.5	13.08	13.64	12.72	13.14	0.463
5.0	13.54	12.23	14.36	13.38	1.073
7.5	14.41	13.39	14.99	14.26	0.808
10.0	14.89	16.05	16.49	15.81	0.825
12.5	16.49	16.39	16.92	16.60	0.283
15.0	17.89	16.34	17.46	17.23	0.798
20.0	18.47	16.97	17.94	17.79	0.760
25.0	18.96	19.83	20.41	19.73	0.730
30.0	20.79	22.00	20.94	21.24	0.660
40.0	24.23	20.41	19.97	21.53	2.341
50.0	21.81	23.02	22.49	22.44	0.606
60.0	21.52	23.32	23.07	22.64	0.976



**Table F25** Release of amoxicillin from the blend films with 40% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	2.18	2.71	3.00	2.63	0.417
1.0	2.80	3.48	2.90	3.06	0.366
1.5	3.24	4.30	3.72	3.76	0.533
2.0	4.79	4.35	5.80	4.98	0.744
2.5	6.43	4.84	8.41	6.56	1.793
3.0	7.01	7.35	9.53	7.96	1.365
3.5	7.30	8.32	10.20	8.61	1.472
4.0	8.99	10.30	12.86	10.72	1.968
4.5	11.70	13.68	15.04	13.48	1.678
5.0	12.91	14.46	15.38	14.25	1.246
7.5	13.64	12.77	14.26	13.56	0.753
10.0	13.32	13.80	14.57	13.90	0.632
12.5	15.11	14.23	13.85	14.39	0.645
15.0	14.51	14.40	15.53	14.81	0.621
20.0	14.47	14.53	14.65	14.55	0.089
25.0	15.57	14.26	14.89	14.91	0.653
30.0	14.70	16.83	15.81	15.78	1.064
40.0	15.14	14.07	16.10	15.10	1.016
50.0	17.17	15.18	15.04	15.80	1.189
60.0	14.51	14.46	16.01	14.99	0.880

**Table F26** Release of amoxicillin from chitosan films content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	8.99	9.38	9.72	9.36	0.363
1.0	9.57	9.09	10.01	9.56	0.460
1.5	8.80	9.57	9.82	9.40	0.530
2.0	10.06	10.93	9.86	10.28	0.567
2.5	10.30	11.36	9.91	10.53	0.751
3.0	10.98	10.15	10.54	10.56	0.411
3.5	11.07	10.58	11.85	11.17	0.641
4.0	12.19	11.56	12.09	11.94	0.338
4.5	11.90	11.17	12.19	11.75	0.523
5.0	11.77	13.76	11.85	12.46	1.127
7.5	13.44	11.56	11.94	12.31	0.996
10.0	10.93	13.25	13.59	12.59	1.448
12.5	11.85	15.62	14.46	13.97	1.932
15.0	13.70	14.46	15.72	14.62	1.018
20.0	14.05	14.51	15.76	14.77	0.888
25.0	14.89	15.72	16.10	15.57	0.622
30.0	17.79	18.13	18.47	18.13	0.338
40.0	19.92	18.38	19.12	19.14	0.774
50.0	19.87	18.62	19.34	19.28	0.631
60.0	21.81	18.38	19.29	19.83	1.777

**Table F27** Release of amoxicillin from the blend films with 80% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	4.59	4.78	5.80	5.06	0.651
1.0	5.85	8.95	9.72	8.17	2.047
1.5	10.25	10.06	10.69	10.33	0.322
2.0	11.70	10.64	12.48	11.61	0.923
2.5	12.38	11.65	13.01	12.35	0.678
3.0	12.77	13.54	14.07	13.46	0.657
3.5	14.22	14.75	14.85	14.60	0.338
4.0	14.75	16.92	17.75	16.47	1.549
4.5	16.30	16.88	17.55	16.91	0.629
5.0	16.97	17.50	18.23	17.57	0.631
7.5	16.83	17.26	18.28	17.46	0.744
10.0	17.36	18.47	18.47	18.10	0.642
12.5	18.18	18.91	19.39	18.83	0.608
15.0	20.36	20.07	19.20	19.87	0.604
20.0	20.79	20.36	19.92	20.36	0.435
25.0	20.21	20.60	20.50	20.44	0.201
30.0	21.28	20.07	20.60	20.65	0.606
40.0	22.05	20.89	20.65	21.20	0.750
50.0	23.11	21.81	20.26	21.73	1.428
60.0	23.94	23.31	24.23	23.82	0.470

**Table F28** Release of amoxicillin from the blend films with 60% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	2.80	3.48	3.29	3.19	0.349
1.0	3.19	4.26	3.43	3.63	0.558
1.5	4.74	5.08	4.55	4.79	0.269
2.0	5.90	6.38	5.56	5.95	0.413
2.5	7.30	7.35	7.16	7.27	0.101
3.0	8.08	7.64	8.46	8.06	0.411
3.5	8.56	8.85	9.57	8.99	0.523
4.0	9.09	9.62	9.72	9.48	0.338
4.5	10.20	9.67	10.88	10.25	0.606
5.0	11.12	10.69	10.40	10.74	0.365
7.5	11.07	11.85	10.54	11.15	0.657
10.0	11.51	10.98	12.14	11.54	0.581
12.5	12.04	11.94	12.81	12.27	0.477
15.0	12.14	12.28	11.50	11.97	0.417
20.0	12.81	13.78	12.04	12.88	0.872
25.0	12.62	13.44	11.51	12.52	0.971
30.0	12.52	12.86	13.30	12.89	0.388
40.0	13.30	11.85	13.64	12.93	0.950
50.0	13.85	12.62	12.28	12.92	0.827
60.0	13.68	11.70	12.33	12.57	1.013

**Table F29** Release of amoxicillin from the blend films with 50% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	2.71	2.18	3.00	2.63	0.417
1.0	3.29	2.85	3.38	3.18	0.283
1.5	3.63	4.11	3.34	3.69	0.391
2.0	4.30	4.74	4.79	4.61	0.266
2.5	4.88	5.37	5.08	5.11	0.243
3.0	5.56	6.14	5.75	5.82	0.295
3.5	6.24	6.87	6.53	6.54	0.315
4.0	7.35	6.72	7.50	7.19	0.411
4.5	8.61	7.01	7.74	7.79	0.799
5.0	9.86	8.51	9.14	9.17	0.678
7.5	10.40	9.57	10.40	10.12	0.475
10.0	10.06	9.67	10.11	9.95	0.239
12.5	11.07	11.51	10.40	10.99	0.560
15.0	11.36	10.15	10.59	10.70	0.612
20.0	11.85	12.38	10.64	11.62	0.892
25.0	11.51	11.94	11.46	11.64	0.266
30.0	11.56	11.70	11.61	11.62	0.074
40.0	11.86	11.65	11.85	11.79	0.115
50.0	12.38	11.85	11.41	11.88	0.484
60.0	12.09	11.72	11.80	11.87	0.196

**Table F30** Release of amoxicillin from the blend films with 40% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	1.16	1.69	1.99	1.62	0.421
1.0	1.84	2.61	3.34	2.60	0.750
1.5	2.51	3.48	3.87	3.29	0.697
2.0	3.43	3.97	4.35	3.92	0.461
2.5	4.74	4.79	4.88	4.80	0.074
3.0	5.80	5.27	6.19	5.75	0.461
3.5	5.37	6.82	7.45	6.54	1.066
4.0	6.04	7.25	8.41	7.24	1.185
4.5	6.62	7.45	5.95	6.67	0.751
5.0	7.35	7.64	7.83	7.61	0.243
7.5	7.21	7.50	8.22	7.64	0.523
10.0	7.59	8.03	7.16	7.59	0.435
12.5	7.11	7.64	8.03	7.59	0.461
15.0	8.08	7.59	6.67	7.45	0.712
20.0	7.83	8.46	7.35	7.88	0.558
25.0	7.69	8.70	7.01	7.80	0.852
30.0	7.40	6.62	8.22	7.41	0.798
40.0	7.50	7.83	7.01	7.45	0.413
50.0	7.74	7.64	8.56	7.98	0.505
60.0	9.04	7.35	8.70	8.37	0.896

**Table F31** Release of salicylic acid from chitosan films content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	19.90	19.90	19.95	19.92	0.028
1.0	43.56	43.51	43.75	43.60	0.129
1.5	57.21	57.31	57.51	57.34	0.149
2.0	73.50	73.11	73.60	73.41	0.258
2.5	76.09	76.38	76.53	76.33	0.224
3.0	79.31	79.16	79.02	79.16	0.146
3.5	80.14	80.09	79.89	80.04	0.129
4.0	80.67	80.87	81.02	80.85	0.171
4.5	82.67	82.82	82.72	82.74	0.075
5.0	83.16	83.36	83.26	83.26	0.098
7.5	83.21	83.36	83.36	83.31	0.084
10.0	83.99	83.89	83.99	83.96	0.056
12.5	84.28	84.72	84.92	84.64	0.325
15.0	84.62	84.72	84.82	84.72	0.098
20.0	84.97	85.06	85.11	85.05	0.075
25.0	87.45	87.65	87.75	87.62	0.149
30.0	88.43	88.38	88.04	88.28	0.213
40.0	88.82	88.92	88.77	88.84	0.075
50.0	89.99	89.36	90.19	89.84	0.434
60.0	90.53	89.65	89.99	90.06	0.443

**Table F32** Release of salicylic acid from the blend films with 80% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	59.70	59.80	59.85	59.78	0.075
1.0	68.24	68.33	68.53	68.37	0.149
1.5	78.92	79.16	79.45	79.18	0.269
2.0	81.89	82.33	82.67	82.30	0.391
2.5	83.21	83.36	82.92	83.16	0.224
3.0	83.31	83.45	83.36	83.37	0.075
3.5	83.75	84.23	84.53	84.17	0.394
4.0	84.82	85.06	85.45	85.11	0.320
4.5	85.16	85.50	85.26	85.31	0.176
5.0	85.70	85.94	86.33	85.99	0.320
7.5	86.28	86.43	86.33	86.35	0.075
10.0	86.92	87.26	87.55	87.24	0.317
12.5	88.97	87.99	89.36	88.77	0.703
15.0	89.36	89.80	89.70	89.62	0.231
20.0	90.14	90.58	91.16	90.62	0.514
25.0	91.06	91.31	91.79	91.39	0.373
30.0	91.45	91.75	92.09	91.76	0.317
40.0	91.84	91.94	92.28	92.02	0.231
50.0	92.18	92.14	92.43	92.25	0.157
60.0	92.18	92.67	93.16	92.67	0.488



**Table F33** Release of salicylic acid from the blend films with 60% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	42.92	40.97	43.51	42.47	1.328
1.0	54.04	54.38	55.02	54.48	0.495
1.5	57.90	59.36	60.92	59.39	1.512
2.0	67.65	68.38	68.58	68.20	0.489
2.5	69.70	70.24	70.82	70.25	0.561
3.0	75.94	75.50	76.43	75.96	0.464
3.5	80.38	81.06	80.92	80.79	0.360
4.0	81.80	82.33	81.89	82.01	0.286
4.5	82.92	83.45	83.50	83.29	0.325
5.0	83.94	84.33	84.53	84.27	0.298
7.5	85.11	85.65	84.77	85.18	0.443
10.0	85.60	85.99	85.31	85.63	0.343
12.5	85.89	86.28	85.50	85.89	0.390
15.0	86.48	86.72	85.80	86.33	0.480
20.0	86.77	86.92	86.09	86.59	0.443
25.0	87.16	87.55	86.87	87.19	0.343
30.0	87.94	88.62	87.60	88.06	0.522
40.0	88.53	88.87	88.19	88.53	0.341
50.0	89.11	89.31	89.75	89.39	0.325
60.0	89.21	89.60	90.04	89.62	0.415

**Table F34** Release of salicylic acid from the blend films with 50% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	17.36	17.61	17.51	17.49	0.123
1.0	41.31	41.51	41.51	41.44	0.113
1.5	53.51	53.80	54.04	53.78	0.269
2.0	63.99	62.38	62.77	63.05	0.840
2.5	66.14	66.53	64.97	65.88	0.812
3.0	67.89	68.63	68.82	68.45	0.489
3.5	76.19	76.97	77.26	76.80	0.555
4.0	77.02	78.14	77.41	77.52	0.570
4.5	79.16	80.14	80.92	80.07	0.880
5.0	80.92	80.24	81.11	80.76	0.461
7.5	81.36	80.53	81.80	81.23	0.644
10.0	81.89	81.31	82.04	81.75	0.387
12.5	82.53	83.06	83.45	83.02	0.465
15.0	83.50	84.23	84.38	84.04	0.470
20.0	84.62	84.87	85.65	85.05	0.535
25.0	85.31	85.99	86.53	85.94	0.611
30.0	87.16	86.77	87.55	87.16	0.390
40.0	87.80	86.82	86.97	87.19	0.526
50.0	88.87	89.50	87.80	88.72	0.863
60.0	89.11	89.50	89.40	89.34	0.203

**Table F35** Release of salicylic acid from the blend films with 40% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	41.41	41.56	41.46	41.48	0.075
1.0	58.38	58.87	60.24	59.16	0.961
1.5	65.70	64.82	63.70	64.74	1.002
2.0	69.65	72.43	73.02	71.70	1.798
2.5	75.94	76.58	75.50	76.01	0.539
3.0	78.24	79.16	80.24	79.21	1.001
3.5	80.24	79.94	80.58	80.25	0.317
4.0	81.55	80.19	80.97	80.90	0.685
4.5	82.53	82.33	82.67	82.51	0.171
5.0	82.92	83.50	83.31	83.24	0.298
7.5	84.38	84.97	84.04	84.46	0.469
10.0	85.60	84.77	84.23	84.87	0.688
12.5	85.84	86.38	86.19	86.14	0.272
15.0	86.62	86.87	86.33	86.61	0.269
20.0	86.67	86.82	87.16	86.88	0.250
25.0	86.97	87.31	87.41	87.23	0.231
30.0	87.31	87.36	87.75	87.47	0.241
40.0	87.41	87.45	87.55	87.47	0.075
50.0	88.14	88.23	88.23	88.20	0.056
60.0	88.38	88.48	88.58	88.48	0.098

**Table F36** Release of salicylic acid from chitosan films at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	35.12	28.78	33.65	32.52	3.320
1.0	59.21	60.09	61.70	60.33	1.262
1.5	71.80	70.04	71.60	71.15	0.962
2.0	72.28	71.94	71.65	71.96	0.317
2.5	74.24	74.82	74.58	74.54	0.294
3.0	74.48	75.02	74.87	74.79	0.277
3.5	75.36	75.02	75.16	75.18	0.171
4.0	76.19	75.80	74.82	75.60	0.703
4.5	75.70	75.21	75.75	75.55	0.297
5.0	75.94	76.04	74.72	75.57	0.734
7.5	76.14	75.21	75.94	75.76	0.489
10.0	76.67	76.53	76.33	76.51	0.171
12.5	77.11	76.67	73.16	75.65	2.165
15.0	77.89	78.09	78.63	78.20	0.379
20.0	78.38	78.58	79.26	78.74	0.461
25.0	78.63	79.60	79.21	79.15	0.491
30.0	80.67	81.06	80.82	80.85	0.197
40.0	80.58	80.43	81.02	80.67	0.305
50.0	81.31	81.21	80.82	81.11	0.258
60.0	81.55	80.58	82.23	81.45	0.833

**Table F37** Release of salicylic acid from the blend films with 80% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	20.24	24.14	24.92	23.10	2.509
1.0	57.60	52.53	53.41	54.51	2.711
1.5	62.14	55.07	55.26	57.49	4.028
2.0	68.04	62.77	64.58	65.13	2.677
2.5	72.28	65.70	65.26	67.75	3.934
3.0	75.06	72.82	74.09	73.99	1.125
3.5	76.67	77.26	76.33	76.76	0.469
4.0	77.11	77.50	76.77	77.13	0.366
4.5	77.65	77.80	77.41	77.62	0.197
5.0	78.53	78.28	77.65	78.15	0.453
7.5	78.92	78.38	78.09	78.46	0.421
10.0	79.36	78.77	79.11	79.08	0.294
12.5	79.65	80.33	79.89	79.96	0.346
15.0	80.43	80.92	80.43	80.59	0.282
20.0	81.31	82.09	80.87	81.42	0.618
25.0	82.19	81.65	81.55	81.80	0.341
30.0	82.53	82.19	81.70	82.14	0.417
40.0	82.77	83.31	82.38	82.82	0.465
50.0	83.65	83.50	82.87	83.34	0.415
60.0	84.09	83.50	82.92	83.50	0.585

**Table F38** The release of salicylic acid from the blend films with 60% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	38.48	42.97	43.41	41.62	2.726
1.0	59.07	61.31	63.31	61.23	2.123
1.5	64.82	63.80	65.85	64.82	1.024
2.0	65.75	65.07	66.68	65.83	0.808
2.5	65.90	66.77	67.02	66.56	0.590
3.0	67.41	67.75	68.04	67.73	0.317
3.5	68.04	69.60	68.87	68.84	0.781
4.0	69.99	70.77	71.55	70.77	0.780
4.5	71.55	70.63	71.89	71.36	0.656
5.0	71.80	71.65	72.58	72.01	0.498
7.5	72.43	71.94	72.82	72.40	0.440
10.0	73.16	74.24	74.82	74.07	0.841
12.5	75.46	75.06	75.46	75.33	0.225
15.0	75.94	75.55	75.55	75.68	0.225
20.0	76.82	76.24	75.89	76.32	0.469
25.0	77.16	76.53	76.48	76.72	0.381
30.0	77.36	76.77	77.02	77.05	0.294
40.0	77.45	76.82	77.06	77.11	0.320
50.0	77.02	77.21	76.53	76.92	0.352
60.0	77.11	76.82	77.50	77.15	0.343

**Table F39** Release of salicylic acid from the blend films with 50% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	13.17	17.07	9.27	13.17	3.902
1.0	38.48	43.02	32.92	38.14	5.057
1.5	43.56	44.24	40.09	42.63	2.223
2.0	59.70	65.94	48.68	58.11	8.743
2.5	67.07	66.38	59.02	64.16	4.462
3.0	68.87	69.31	70.04	69.41	0.591
3.5	69.46	69.99	70.53	69.99	0.537
4.0	70.48	71.07	70.82	70.79	0.294
4.5	71.36	72.19	71.60	71.72	0.426
5.0	72.09	72.77	71.94	72.27	0.443
7.5	73.07	73.41	72.58	73.02	0.417
10.0	73.26	73.75	72.82	73.28	0.464
12.5	73.55	73.89	72.92	73.46	0.495
15.0	73.65	74.04	73.16	73.62	0.440
20.0	74.53	73.99	74.63	74.38	0.341
25.0	74.63	74.38	74.43	74.48	0.129
30.0	75.06	74.53	74.72	74.77	0.272
40.0	74.92	74.72	74.87	74.84	0.102
50.0	74.97	74.87	75.02	74.95	0.075
60.0	75.11	74.92	75.16	75.06	0.129

**Table F40** Release of salicylic acid from the blend films with 40% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	26.24	30.39	31.17	29.27	2.648
1.0	38.14	40.73	38.82	39.23	1.340
1.5	52.43	45.80	52.43	50.22	3.830
2.0	52.04	50.19	53.26	51.83	1.547
2.5	54.87	53.51	55.60	54.66	1.065
3.0	56.68	54.19	56.43	55.77	1.371
3.5	58.92	57.51	57.31	57.91	0.878
4.0	60.82	62.14	58.97	60.64	1.593
4.5	62.58	63.65	61.36	62.53	1.147
5.0	63.07	64.48	62.82	63.46	0.895
7.5	63.80	65.11	64.09	64.33	0.692
10.0	66.19	67.75	66.14	66.69	0.916
12.5	67.89	68.53	66.87	67.76	0.837
15.0	69.50	69.65	67.41	68.85	1.255
20.0	70.43	70.04	68.43	69.63	1.060
25.0	71.02	71.07	69.36	70.48	0.972
30.0	71.75	71.46	70.04	71.08	0.913
40.0	72.09	71.89	70.87	71.62	0.655
50.0	73.46	72.77	72.53	72.92	0.480
60.0	73.50	73.89	73.55	73.65	0.213



**Table F41** Release of salicylic acid from chitosan films at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	4.73	5.27	5.80	5.27	0.537
1.0	20.49	18.63	19.85	19.66	0.942
1.5	29.36	28.63	37.17	31.72	4.731
2.0	36.00	36.48	36.68	36.39	0.352
2.5	38.63	39.36	39.61	39.20	0.508
3.0	45.02	46.09	47.12	46.08	1.049
3.5	47.70	48.14	48.38	48.08	0.346
4.0	49.36	51.12	51.65	50.71	1.199
4.5	52.63	51.80	53.12	52.51	0.666
5.0	53.85	55.07	55.21	54.71	0.750
7.5	56.43	57.31	55.99	56.58	0.671
10.0	57.80	59.26	57.46	58.17	0.959
12.5	60.14	60.73	58.97	59.94	0.894
15.0	61.02	61.80	60.92	61.25	0.481
20.0	61.55	61.75	61.16	61.49	0.298
25.0	61.99	61.90	61.46	61.78	0.286
30.0	62.68	61.99	62.29	62.32	0.343
40.0	62.92	62.33	62.53	62.59	0.298
50.0	62.19	61.55	61.90	61.88	0.317
60.0	61.36	61.51	61.94	61.60	0.305

**Table F42** The release of salicylic acid from the blend films with 80% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	8.78	9.80	9.36	9.32	0.514
1.0	26.73	31.12	32.05	29.96	2.840
1.5	33.02	36.04	38.29	35.78	2.643
2.0	49.90	48.87	51.80	50.19	1.485
2.5	54.24	55.95	56.38	55.52	1.134
3.0	57.80	58.82	59.26	58.63	0.751
3.5	61.12	62.87	63.26	62.42	1.143
4.0	62.82	63.65	64.82	63.77	1.005
4.5	64.97	66.04	66.33	65.78	0.719
5.0	67.41	66.68	66.97	67.02	0.368
7.5	68.33	68.19	67.75	68.09	0.305
10.0	69.94	69.50	70.58	70.01	0.539
12.5	70.48	70.77	71.70	70.98	0.637
15.0	72.09	72.33	71.99	72.14	0.176
20.0	72.19	72.53	72.63	72.45	0.231
25.0	72.58	72.72	72.92	72.74	0.171
30.0	72.67	72.82	63.02	69.50	5.618
40.0	73.11	73.41	73.55	73.36	0.224
50.0	73.36	73.50	73.60	73.49	0.123
60.0	73.55	73.70	73.46	73.57	0.123

**Table F43** Release of salicylic acid from the blend films with 60% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	22.44	25.51	23.51	23.82	1.560
1.0	32.83	35.85	32.14	33.61	1.973
1.5	40.58	42.97	45.21	42.92	2.317
2.0	48.87	50.48	49.80	49.72	0.808
2.5	55.07	57.70	58.58	57.12	1.828
3.0	58.09	58.82	59.46	58.79	0.683
3.5	60.43	62.68	62.09	61.73	1.164
4.0	62.63	63.75	64.53	63.64	0.956
4.5	63.80	65.46	66.09	65.11	1.184
5.0	65.75	66.92	66.77	66.48	0.638
7.5	68.14	68.53	67.65	68.11	0.440
10.0	68.87	68.33	68.24	68.48	0.341
12.5	69.60	68.97	68.43	69.00	0.586
15.0	69.75	69.31	69.02	69.36	0.368
20.0	69.85	69.70	69.26	69.60	0.305
25.0	69.99	70.33	69.99	70.11	0.197
30.0	70.09	70.87	70.33	70.43	0.399
40.0	70.28	71.16	70.72	70.72	0.439
50.0	71.16	71.21	70.77	71.05	0.241
60.0	71.55	71.89	71.11	71.52	0.391

**Table F44** Release of salicylic acid from the blend films with 50% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	19.80	22.29	23.70	21.93	1.975
1.0	33.12	34.39	39.26	35.59	3.245
1.5	36.68	40.92	45.95	41.18	4.639
2.0	47.95	48.53	51.65	49.38	1.993
2.5	51.56	52.48	53.12	52.38	0.785
3.0	55.46	56.53	56.82	56.27	0.719
3.5	57.02	57.46	57.99	57.49	0.489
4.0	58.92	60.73	61.80	60.48	1.454
4.5	61.41	61.60	62.04	61.68	0.325
5.0	62.72	63.07	63.55	63.12	0.417
7.5	63.94	64.63	65.21	64.59	0.635
10.0	64.48	65.11	65.36	64.98	0.453
12.5	65.21	65.46	65.85	65.50	0.320
15.0	65.70	65.94	66.63	66.09	0.480
20.0	65.94	66.77	66.82	66.51	0.493
25.0	67.02	67.41	67.55	67.33	0.277
30.0	67.50	67.60	67.36	67.49	0.123
40.0	67.55	67.80	67.75	67.70	0.129
50.0	67.99	67.89	68.04	67.98	0.075
60.0	68.33	67.94	68.53	68.27	0.298

**Table F45** Release of salicylic acid from the blend films with 40% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
0.5	31.54	32.78	34.00	32.77	1.228
1.0	35.51	37.02	39.07	37.20	1.787
1.5	39.95	42.53	41.31	41.26	1.293
2.0	43.51	44.14	42.09	43.25	1.049
2.5	46.53	47.70	44.73	46.32	1.499
3.0	54.09	57.16	52.92	54.73	2.192
3.5	58.73	61.07	58.24	59.34	1.512
4.0	60.38	60.73	60.97	60.69	0.294
4.5	62.24	63.02	63.65	62.97	0.708
5.0	63.80	63.99	64.77	64.19	0.516
7.5	64.58	64.82	64.87	64.76	0.157
10.0	64.97	64.82	64.82	64.87	0.084
12.5	65.11	65.41	65.26	65.26	0.146
15.0	65.60	65.94	65.70	65.75	0.176
20.0	65.90	66.09	65.85	65.94	0.129
25.0	66.19	66.33	65.94	66.16	0.197
30.0	66.24	66.19	66.24	66.22	0.028
40.0	65.46	65.60	65.80	65.62	0.171
50.0	65.94	65.70	65.85	65.83	0.123
60.0	65.60	66.29	65.75	65.88	0.360

**Table F46** Release of diclofenac sodium from chitosan films at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	29.23	29.15	29.33	29.24	0.090
20	56.77	56.66	56.88	56.77	0.107
30	65.33	65.51	65.62	65.48	0.145
40	67.34	67.30	65.83	66.82	0.858
50	68.41	68.23	68.34	68.33	0.090
60	69.99	69.56	70.20	69.91	0.328
70	71.17	71.24	71.31	71.24	0.072
80	71.88	71.81	72.03	71.91	0.109
90	71.96	71.99	72.03	71.99	0.036
100	72.10	71.96	72.17	72.07	0.109
110	72.53	72.46	72.92	72.64	0.251
120	74.68	74.43	74.61	74.57	0.129
140	75.54	75.57	75.68	75.60	0.075
160	76.47	76.54	76.68	76.56	0.109
180	78.33	78.62	78.80	78.58	0.235

**Table F47** Release of diclofenac sodium from the blend films with 80% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	32.95	33.17	33.13	33.08	0.115
20	57.52	57.35	57.06	57.31	0.235
30	69.16	69.99	69.56	69.57	0.412
40	71.20	71.45	71.74	71.47	0.269
50	75.57	76.15	77.11	76.28	0.778
60	76.58	75.18	77.61	76.46	1.222
70	79.15	79.73	79.12	79.33	0.342
80	79.62	82.31	80.80	80.91	1.346
90	80.41	81.48	81.02	80.97	0.539
100	81.84	82.41	81.41	81.89	0.503
110	82.06	80.69	82.81	81.85	1.071
120	81.95	82.20	82.41	82.19	0.233
140	82.63	83.13	82.66	82.81	0.280
160	82.34	82.56	81.91	82.27	0.328
180	82.74	82.88	83.13	82.92	0.199

**Table F48** Release of diclofenac sodium from the blend films with 60% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	33.49	33.74	33.67	33.63	0.129
20	62.82	63.07	62.64	62.85	0.216
30	68.41	69.23	68.23	68.62	0.535
40	71.20	69.99	72.21	71.13	1.112
50	73.46	72.92	73.78	73.39	0.434
60	74.32	73.96	74.53	74.27	0.290
70	75.04	74.32	74.75	74.70	0.361
80	76.90	74.82	79.26	76.99	2.222
90	77.79	78.08	78.51	78.13	0.361
100	79.55	80.09	79.62	79.75	0.293
110	80.91	81.05	81.27	81.08	0.180
120	83.27	83.13	83.09	83.17	0.095
140	82.63	81.91	85.92	83.49	2.139
160	82.84	82.20	85.17	83.40	1.564
180	83.02	82.52	82.92	82.82	0.264



**Table F49** Release of diclofenac sodium from the blend films with 50% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.00
10	15.44	15.58	15.22	15.41	0.18
20	26.97	26.68	28.01	27.22	0.70
30	33.20	33.42	34.10	33.57	0.47
40	35.32	37.82	34.92	36.02	1.57
50	36.57	36.25	37.71	36.84	0.77
60	46.38	46.56	47.31	46.75	0.49
70	52.04	52.61	53.19	52.61	0.57
80	55.48	56.12	56.70	56.10	0.61
90	57.27	57.70	58.13	57.70	0.43
100	59.92	60.35	59.78	60.02	0.30
110	61.71	62.29	61.78	61.93	0.31
120	61.64	61.78	61.89	61.77	0.13
140	63.47	63.86	62.89	63.41	0.49
160	64.65	64.33	63.97	64.31	0.34
180	64.40	63.75	64.65	64.27	0.46

**Table F50** Release of diclofenac sodium from the blend films with 40% chitosan content at pH 2.0

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	13.36	13.22	13.61	13.40	0.199
20	23.17	23.50	23.75	23.47	0.287
30	29.76	30.19	30.05	30.00	0.219
40	40.04	38.93	41.30	40.09	1.183
50	47.46	47.89	46.53	47.29	0.696
60	50.50	50.04	50.97	50.50	0.466
70	51.86	51.97	52.36	52.07	0.264
80	53.26	53.44	52.94	53.21	0.254
90	53.72	53.19	54.26	53.72	0.537
100	53.87	54.51	53.65	54.01	0.447
110	57.38	57.95	58.35	57.89	0.486
120	58.49	59.60	59.13	59.07	0.558
140	60.24	60.14	60.71	60.36	0.305
160	60.21	60.60	60.89	60.57	0.342
180	60.35	60.14	60.53	60.34	0.197

**Table F51** Release of diclofenac sodium from chitosan films at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	28.22	27.08	28.58	27.96	0.786
20	49.25	47.46	49.96	48.89	1.291
30	57.49	58.92	58.27	58.23	0.718
40	61.00	62.75	61.64	61.80	0.888
50	64.29	62.89	63.68	63.62	0.700
60	64.29	64.65	66.44	65.13	1.151
70	67.51	67.77	68.91	68.06	0.745
80	67.62	68.02	68.12	67.92	0.264
90	66.33	65.97	67.87	66.73	1.009
100	68.77	68.23	68.59	68.53	0.274
110	68.48	67.66	67.16	67.77	0.669
120	68.52	68.88	69.95	69.11	0.746
140	69.66	71.10	71.81	70.86	1.094
160	71.70	72.17	71.42	71.76	0.380
180	76.00	75.18	71.45	74.21	2.424

**Table F52** Release of diclofenac sodium from the blend films with 80% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	26.40	28.26	26.93	27.20	0.959
20	33.78	34.42	32.74	33.64	0.849
30	40.29	38.61	40.47	39.79	1.028
40	47.89	43.88	49.36	47.04	2.837
50	50.82	52.18	52.58	51.86	0.921
60	54.87	55.73	55.41	55.34	0.434
70	59.99	60.78	58.45	59.74	1.184
80	61.75	61.10	62.50	61.78	0.699
90	63.32	63.00	64.51	63.61	0.792
100	65.44	66.87	65.72	66.01	0.758
110	68.59	69.91	71.24	69.91	1.325
120	71.85	71.10	72.56	71.84	0.734
140	73.93	72.82	72.99	73.24	0.596
160	74.07	73.50	74.10	73.89	0.342
180	74.18	73.71	74.53	74.14	0.413

**Table F53** Release of diclofenac sodium from the blend films with 60% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	21.85	16.12	26.86	21.61	5.376
20	30.44	32.95	29.37	30.92	1.838
30	39.58	41.30	35.71	38.86	2.862
40	40.90	41.83	41.30	41.34	0.467
50	46.02	46.56	46.70	46.43	0.359
60	48.53	48.78	48.32	48.54	0.233
70	50.79	51.40	51.79	51.33	0.505
80	52.58	52.72	53.12	52.81	0.278
90	53.19	54.66	52.54	53.46	1.083
100	53.08	53.65	54.55	53.76	0.740
110	53.76	57.38	58.09	56.41	2.323
120	55.52	53.26	54.91	54.56	1.167
140	54.58	56.91	57.49	56.33	1.537
160	55.84	57.13	57.38	56.78	0.826
180	58.88	59.35	59.03	59.09	0.238

**Table F54** Release of diclofenac sodium from the blend films with 50% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	24.21	23.35	24.43	24.00	0.569
20	34.10	35.39	35.89	35.12	0.924
30	42.44	41.01	41.65	41.70	0.718
40	44.16	43.16	45.42	44.25	1.131
50	44.91	45.20	44.16	44.76	0.536
60	47.03	44.88	47.35	46.42	1.343
70	47.85	48.17	49.53	48.52	0.894
80	48.57	49.61	50.32	49.50	0.882
90	51.04	51.33	50.29	50.88	0.536
100	52.58	52.83	51.29	52.23	0.826
110	55.59	56.55	57.02	56.39	0.731
120	58.06	57.06	58.81	57.98	0.880
140	60.46	60.71	59.99	60.39	0.363
160	59.56	59.38	57.99	58.98	0.863
180	58.49	59.28	59.96	59.24	0.735

**Table F55** Release of diclofenac sodium from the blend films with 40% chitosan content at pH 5.5

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	14.76	14.29	13.93	14.33	0.413
20	21.02	24.53	25.50	23.69	2.356
30	32.81	32.06	28.87	31.24	2.092
40	38.83	39.94	36.14	38.30	1.952
50	40.33	41.73	42.26	41.44	0.998
60	44.31	45.13	42.69	44.04	1.239
70	49.75	46.92	48.57	48.41	1.421
80	50.11	49.71	50.68	50.17	0.486
90	53.08	52.83	51.29	52.40	0.970
100	51.68	52.11	52.36	52.05	0.344
110	52.15	51.00	53.08	52.08	1.041
120	51.11	52.47	53.69	52.42	1.290
140	51.72	52.22	53.33	52.42	0.825
160	52.83	52.94	53.30	53.02	0.244
180	51.97	53.30	52.61	52.63	0.663

**Table F56** Release of diclofenac sodium from chitosan films at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	51.25	51.29	52.01	51.52	0.424
20	52.01	53.44	52.40	52.61	0.740
30	53.08	53.76	53.55	53.46	0.348
40	54.91	55.34	53.80	54.68	0.795
50	56.05	54.91	54.15	55.04	0.956
60	54.87	57.31	55.19	55.79	1.323
70	58.52	57.06	54.62	56.73	1.972
80	58.92	57.23	56.38	57.51	1.294
90	58.04	59.17	58.49	58.57	0.568
100	60.49	59.74	59.31	59.85	0.598
110	61.32	60.35	59.71	60.46	0.811
120	62.50	59.20	61.43	61.04	1.680
140	63.93	60.96	60.71	61.87	1.793
160	62.79	60.89	60.35	61.34	1.280
180	63.93	58.56	61.35	61.28	2.687



**Table F57** Release of diclofenac sodium from the blend films with 80% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	64.90	64.25	65.76	64.97	0.755
20	63.97	64.51	65.33	64.60	0.686
30	64.90	62.71	63.22	63.61	1.144
40	66.48	66.82	67.16	66.82	0.340
50	65.44	67.51	64.65	65.87	1.480
60	67.05	64.97	64.40	65.47	1.395
70	69.66	67.87	67.98	68.51	1.004
80	69.16	68.12	64.54	67.28	2.424
90	69.66	68.48	69.34	69.16	0.611
100	68.95	71.13	67.16	69.08	1.991
110	68.84	69.66	68.02	68.84	0.824
120	69.63	68.48	68.12	68.74	0.786
140	68.59	69.31	69.91	69.27	0.663
160	68.80	69.77	67.98	68.85	0.896
180	70.13	70.31	68.80	69.75	0.822

**Table F58** Release of diclofenac sodium from the blend films with 60% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	46.99	48.07	47.46	47.50	0.539
20	48.57	49.61	48.07	48.75	0.786
30	49.03	48.17	47.56	48.26	0.738
40	50.07	49.32	50.90	50.10	0.788
50	48.57	50.18	49.75	49.50	0.835
60	49.66	49.25	50.47	49.79	0.619
70	51.93	52.15	52.36	52.15	0.215
80	52.94	50.82	51.50	51.75	1.079
90	53.30	52.40	52.22	52.64	0.576
100	52.01	51.86	50.57	51.48	0.789
110	53.22	52.90	53.30	53.14	0.210
120	53.55	50.90	50.57	51.67	1.631
140	51.29	50.54	52.33	51.38	0.899
160	51.75	52.40	52.22	52.13	0.333
180	52.83	52.47	52.58	52.63	0.184

**Table F59** The release of diclofenac sodium from the blend films with 50% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	30.12	30.66	32.16	30.98	1.058
20	34.06	35.53	32.81	34.13	1.362
30	35.39	34.92	34.49	34.93	0.448
40	35.42	35.57	32.74	34.57	1.594
50	36.25	36.35	35.74	36.12	0.325
60	38.75	35.96	34.89	36.53	1.997
70	39.40	36.10	36.64	37.38	1.768
80	36.35	37.82	34.99	36.39	1.415
90	37.82	38.50	37.46	37.93	0.528
100	37.45	36.71	36.71	36.96	0.426
110	36.73	38.90	40.22	38.62	1.761
120	39.76	38.93	40.29	39.66	0.686
140	41.26	41.27	39.36	40.63	1.099
160	37.82	42.59	42.98	41.13	2.871
180	40.47	39.68	41.51	40.56	0.916

**Table F60** Release of diclofenac sodium from the blend films with 40% chitosan content at pH 7.2

Time (minutes)	Amount of drug release (%)			Average	Standard deviation
	X1	X2	X3		
0.0	0.00	0.00	0.00	0.00	0.000
10	27.08	30.48	24.82	27.46	2.849
20	30.66	25.00	26.93	27.53	2.876
30	26.90	23.60	24.07	24.86	1.783
40	31.59	26.79	25.25	27.88	3.306
50	30.44	27.94	25.90	28.09	2.278
60	29.76	30.27	29.23	29.75	0.519
70	31.55	30.59	28.83	30.32	1.380
80	32.16	29.08	29.44	30.23	1.685
90	35.85	31.45	25.82	31.04	5.027
100	35.64	34.24	27.04	32.31	4.613
110	33.02	31.05	36.28	33.45	2.641
120	33.09	33.85	33.49	33.48	0.376
140	33.78	34.10	32.66	33.51	0.752
160	34.06	32.77	33.74	33.52	0.671
180	35.35	33.60	34.78	34.57	0.895

## CURRICULUM VITAE

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1. S. Kruaykitanon, N. Kruea-ongarjnukool, Y. Pornputtkul, and S. Singhanat (2000) "Mechanical properties of LDPE mixed with pulp from waste newspaper", The extended abstract of the 26<sup>th</sup> Congress on Science and Technology of Thailand (Queen Sirikit, National Convention Center, Bangkok, October 18-20), The Science Society of Thailand (STT), 709.

**Presentation:**

1. Poster presentation on the 5<sup>th</sup> Asia Pacific Chitin-Chitosan Symposium and Exhibition in the topic of drug release characteristic of crosslinked chitosan/silk fibroin blend films at the Emerald Hotel, Bangkok, on 13-15 March 2002

