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APPENDICES

Appendix A Determination of Molecular Weight of Chitosan and Alginate

Table A1 Running time of solvent and chitosan solution Treatment 1

Concentration (g/100 mL)	Time (second)			
	1	2	3	Average
0.0000	205.09	205.10	205.17	205.1
0.0063	214.37	214.15	214.14	214.2
0.0125	224.03	224.01	223.66	223.9
0.0250	244.49	244.13	244.30	244.3
0.0500	289.92	290.01	290.07	290.0
0.1000	397.29	397.07	397.16	397.2

Table A2 The data of relative viscosity (η_{rel}), specific viscosity (η_{sp}), reduced viscosity (η_{red})

Concentration (g/100 mL)	η_{rel}	η_{sp}	η_{red}	$\ln[\eta_{rel}]/c$
0.0000				
0.00625	1.04436	0.04436	7.09828	6.94533
0.0125	1.09155	0.09155	7.32449	7.00834
0.0250	1.19104	0.19104	7.64170	6.99316
0.0500	1.41380	0.41380	8.27613	6.92571
0.1000	1.93629	0.93629	9.36297	6.60777

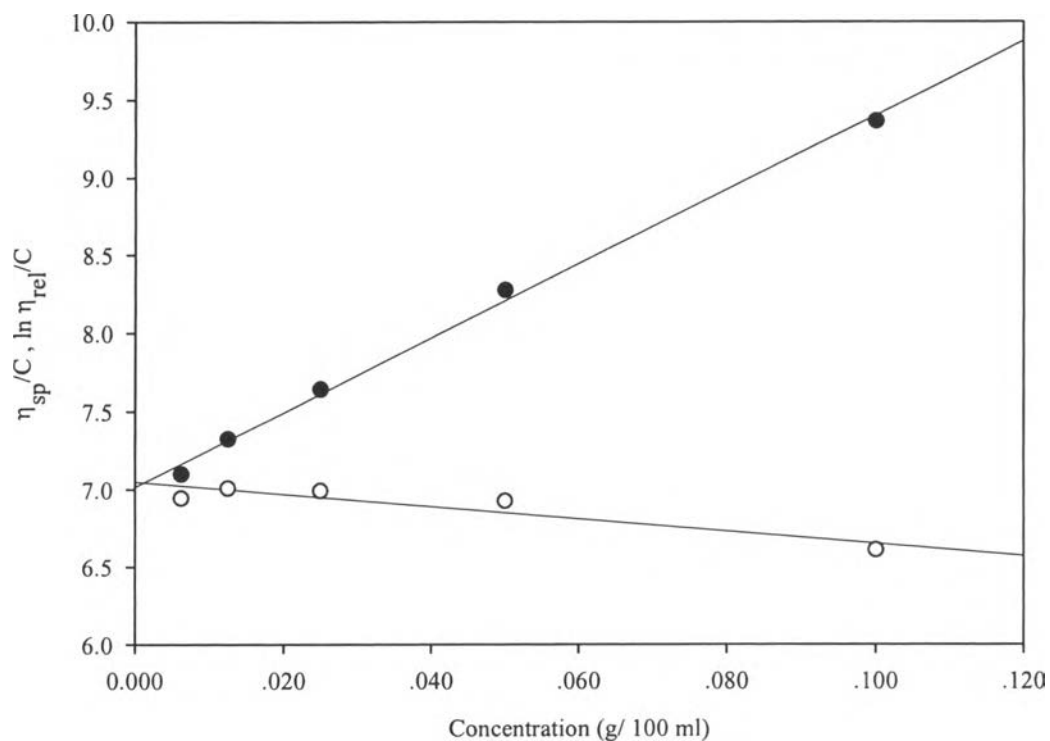


Figure A1 The plot of reduced viscosity (η_{sp}/c) and $\ln((\eta_{rel})/c)$ versus concentration of chitosan solution: • = (η_{sp}/c) and ○ = $\ln((\eta_{rel})/c)$.

$$\% \text{ DD} = 83.58$$

$$\begin{aligned} K &= 1.64 \times 10^{-30} \times \text{DD}^{14} \\ &= 1.64 \times 10^{-30} \times (83.58)^{14} \\ &= 1.3313 \times 10^{-3} \text{ ml/g} \end{aligned}$$

$$\begin{aligned} a &= (-1.02 \times 10^{-2}) \times \text{DD} + 1.82 \\ &= (-1.02 \times 10^{-2}) \times 83.58 + 1.82 \\ &= 0.967484 \end{aligned}$$

$$[\eta] = KM^a = (1.3313 \times 10^{-3})M^{0.967484}$$

$$\text{intercept} = [\eta] = 7.0339$$

From calculaiton;

$$M = 822697$$

Table A3 Running time of solvent and chitosan solution Treatment 2

Concentration (g/100 mL)	Time (second)			
	1	2	3	Average
0.0000	204.93	205.01	205.01	205.0
0.0125	222.11	222.17	222.29	222.2
0.0250	240.97	241.12	241.42	241.2
0.0500	283.18	283.06	283.10	283.1
0.100	378.40	378.62	378.74	378.6

Table A4 The data of relative viscosity (η_{rel}), specific viscosity (η_{sp}), reduced viscosity (η_{red})

Concentration (g/100 mL)	η_{rel}	η_{sp}	η_{red}	$\ln[\eta_{rel}]/c$
0.0000				
0.00625	1.08394	0.08394	6.71534	6.44833
0.0125	1.17650	0.17650	7.06008	6.50183
0.0250	1.38115	0.38115	7.62305	6.45837
0.0500	1.84691	0.84691	8.46914	6.13516
0.1000	1.08394	0.08394	6.71534	6.448335

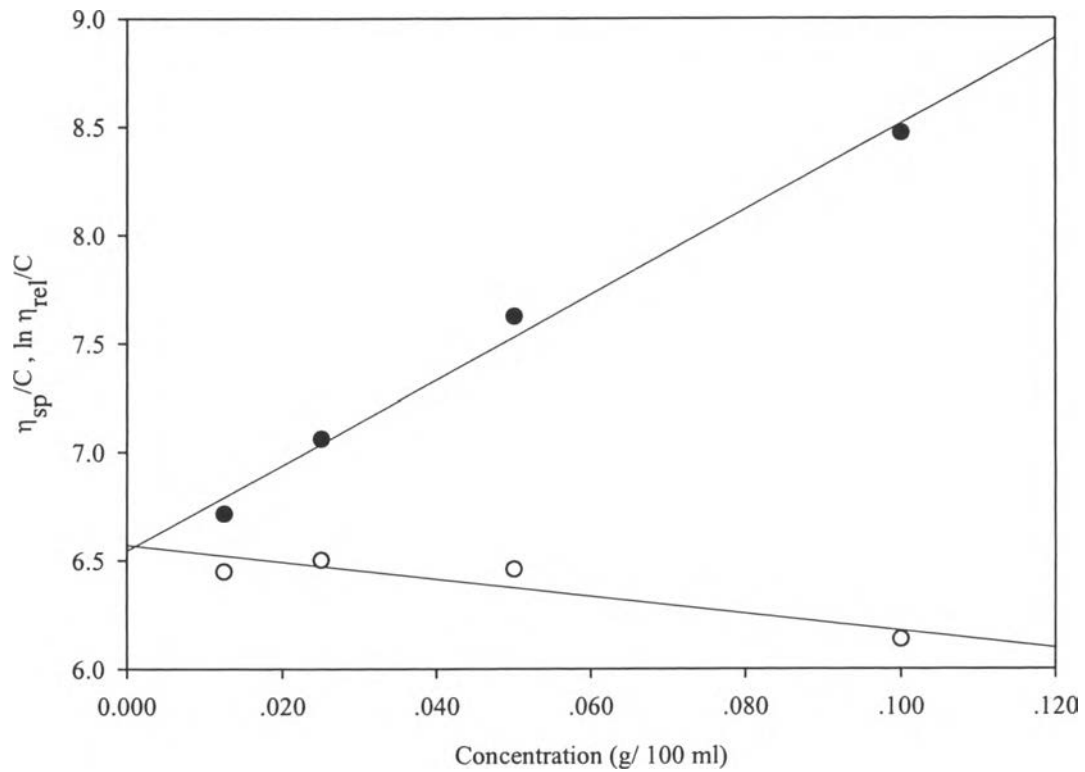


Figure A2 The plot of reduced viscosity (η_{sp}/c) and $\ln((\eta_{rel})/c)$ versus concentration of chitosan solution: • = (η_{sp}/c) and ○ = $\ln((\eta_{rel})/c)$.

$$\% \text{ DD} = 92.456$$

$$\begin{aligned} K &= 1.64 \times 10^{-30} \times \text{DD}^{14} \\ &= 1.64 \times 10^{-30} \times (92.456)^{14} \\ &= 5.4693 \times 10^{-3} \text{ ml/g} \end{aligned}$$

$$\begin{aligned} a &= (-1.02 \times 10^{-2}) \times \text{DD} + 1.82 \\ &= (-1.02 \times 10^{-2}) \times 92.456 + 1.82 \\ &= 0.8769 \end{aligned}$$

$$[\eta] = KM^a = (5.4693 \times 10^{-3})M^{0.8769}$$

$$\text{intercept} = [\eta] = 6.5576$$

From calculaiton;

$$M = 619,108$$

Table A5 Running time of solvent and chitosan solution Treatment 3

Concentration (g/100 mL)	Time (second)			
	1	2	3	Average
0.0000	204.94	205.04	204.95	205.0
0.00625	212.71	212.66	212.63	212.7
0.0125	220.67	220.67	220.66	220.7
0.0250	238.23	238.17	238.34	238.2
0.0500	276.02	276.07	276.17	276.1
0.1000	362.01	361.96	362.23	362.1

Table A6 The data of relative viscosity (η_{rel}), specific viscosity (η_{sp}), reduced viscosity (η_{red})

Concentration (g/100 mL)	η_{rel}	η_{sp}	η_{red}	$\ln[\eta_{rel}]/c$
0.0000				
0.00625	1.03751	0.03751	6.00263	5.89277
0.0125	1.07654	0.07654	6.12362	5.90056
0.0250	1.16231	0.16231	6.49244	6.01641
0.0500	1.34691	0.34691	6.93835	5.95637
0.1000	1.76638	0.76638	7.66379	5.68932

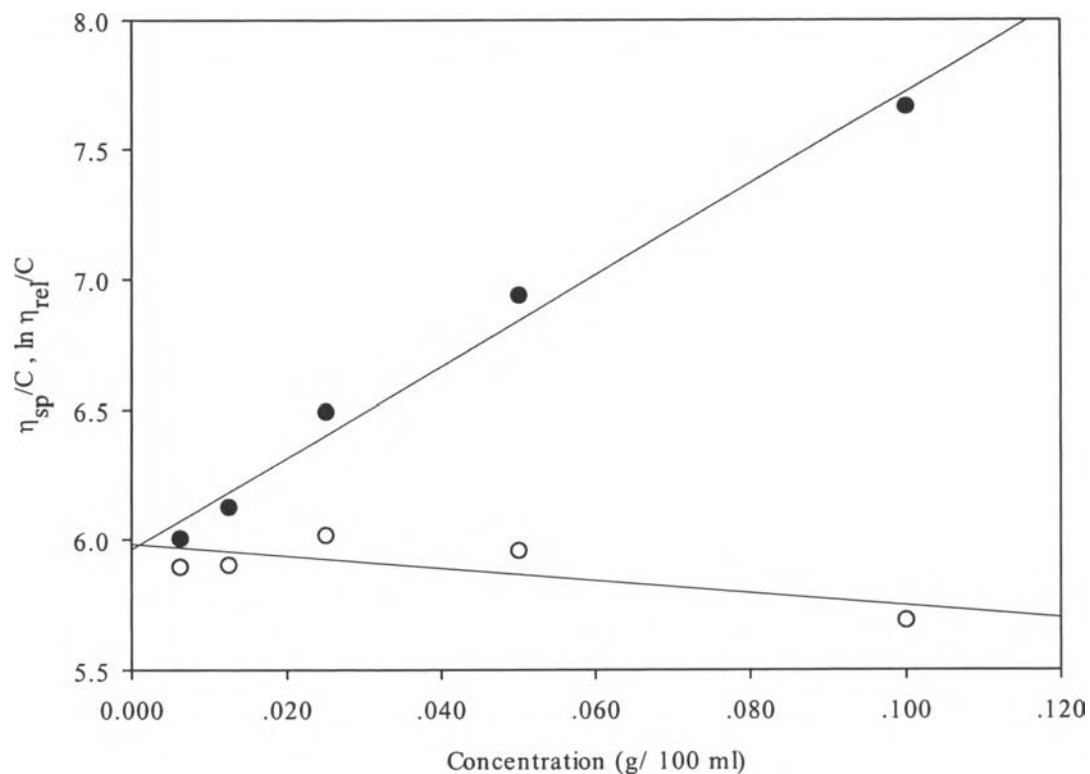


Figure A3 The plot of reduced viscosity (η_{sp}/c) and $\ln((\eta_{rel})/c)$ versus concentration of chitosan solution: • = (η_{sp}/c) and ○ = $\ln((\eta_{rel})/c)$.

$$\% \text{ DD} = 93.163$$

$$\begin{aligned} K &= 1.64 \times 10^{-30} \times \text{DD}^{14} \\ &= 1.64 \times 10^{-30} \times (93.163)^{14} \\ &= 6.0849 \times 10^{-3} \text{ ml/g} \end{aligned}$$

$$\begin{aligned} a &= (-1.02 \times 10^{-2}) \times \text{DD} + 1.82 \\ &= (-1.02 \times 10^{-2}) \times 93.163 + 1.82 \\ &= 0.8697 \end{aligned}$$

$$[\eta] = KM^a = (6.0849 \times 10^{-3})M^{0.8697}$$

$$\text{intercept} = [\eta] = 5.97195$$

from calculation;

$$M = 549,136$$

Table A7 Running time of solvent and chitosan solution Treatment 4

Concentration (g/100 mL)	Time (second)			
	1	2	3	Average
0.0000	204.53	204.73	204.79	204.7
0.0625	212.23	212.32	212.35	212.3
0.0125	220.32	220.13	220.14	220.2
0.0250	235.95	235.02	235.21	235.4
0.0500	271.20	271.29	271.19	271.2
0.100	342.42	342.73	342.53	342.6

Table A8 The data of relative viscosity (η_{rel}), specific viscosity (η_{sp}), reduced viscosity (η_{red})

Concentration (g/100 mL)	η_{rel}	η_{sp}	η_{red}	$\ln[\eta_{rel}]/c$
0.0000				
0.00625	1.03721	0.03721	5.95391	5.84580
0.0125	1.07579	0.07579	6.06335	5.84456
0.0250	1.15003	0.15003	6.00146	5.59175
0.0500	1.32510	0.32510	6.50207	5.62981
0.1000	1.67362	0.67362	6.73625	5.14992

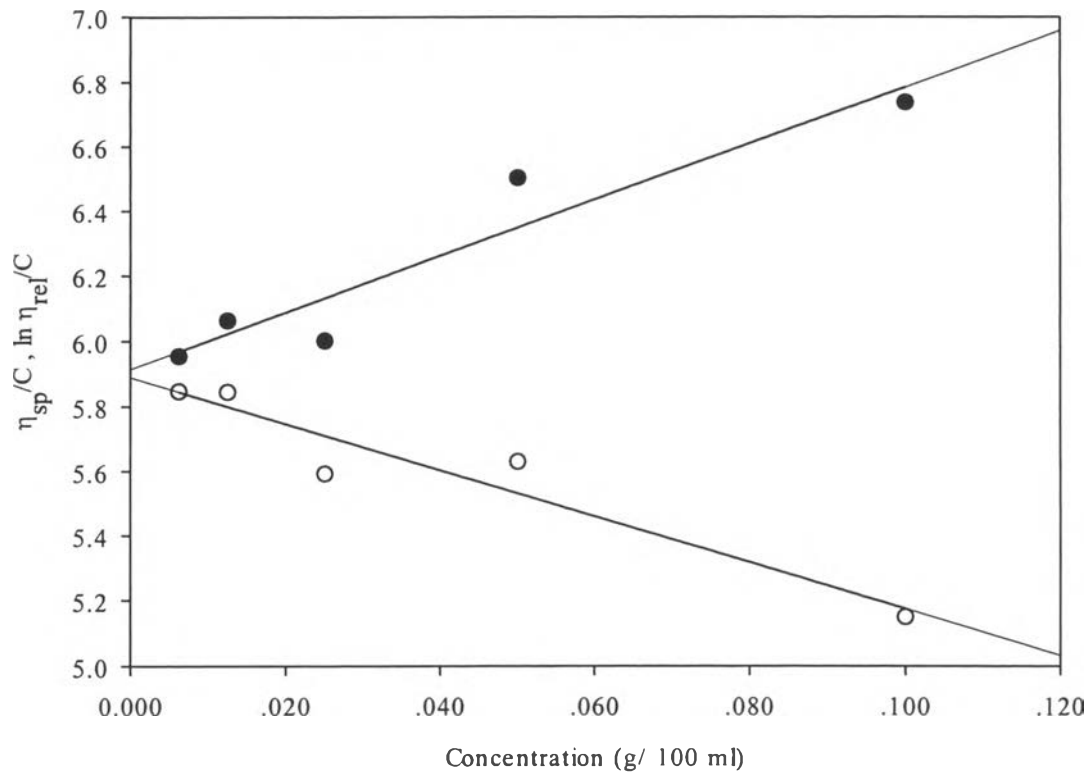


Figure A4 The plot of reduced viscosity (η_{sp}/c) and $\ln((\eta_{rel})/c)$ versus concentration of chitosan solution: • = (η_{sp}/c) and ○ = $\ln((\eta_{rel})/c)$.

$$\% \text{ DD} = 93.546$$

$$\begin{aligned} K &= 1.64 \times 10^{-30} \times \text{DD}^{14} \\ &= 1.64 \times 10^{-30} \times (93.546)^{14} \\ &= 6.4446 \times 10^{-3} \text{ ml/g} \end{aligned}$$

$$\begin{aligned} a &= (-1.02 \times 10^{-2}) \times \text{DD} + 1.82 \\ &= (-1.02 \times 10^{-2}) \times 93.546 + 1.82 \\ &= 0.8658 \end{aligned}$$

$$[\eta] = KM^a = (6.4446 \times 10^{-3})M^{0.8658}$$

$$\text{intercept} = [\eta] = 5.9018$$

from calculation;

$$M = 538,098$$

Table A9 Running time of solvent and alginate solution

Concentration (g/100 mL)	Time (second)			
	1	2	3	Average
0.0000	104.67	104.63	104.61	104.612
0.00625	111.31	111.47	111.30	111.384
0.0125	118.29	118.41	118.50	118.488
0.0250	133.10	133.24	133.30	133.188
0.0500	167.73	167.75	167.78	167.812
0.1000	252.54	252.10	252.48	252.494

Table A10 The data of relative viscosity (η_{rel}), specific viscosity (η_{sp}), reduced viscosity (η_{red})

Concentration (g/100 mL)	η_{rel}	η_{sp}	η_{red}	$\ln[\eta_{rel}]/c$
0.0000				
0.00625	1.06473	0.06473	10.35751	10.03607
0.0125	1.13264	0.13264	10.61140	9.96427
0.0250	1.27316	0.27316	10.92647	9.45172
0.0500	1.60413	0.60413	12.08274	9.45172
0.1000	2.41362	1.41362	14.13623	8.81129

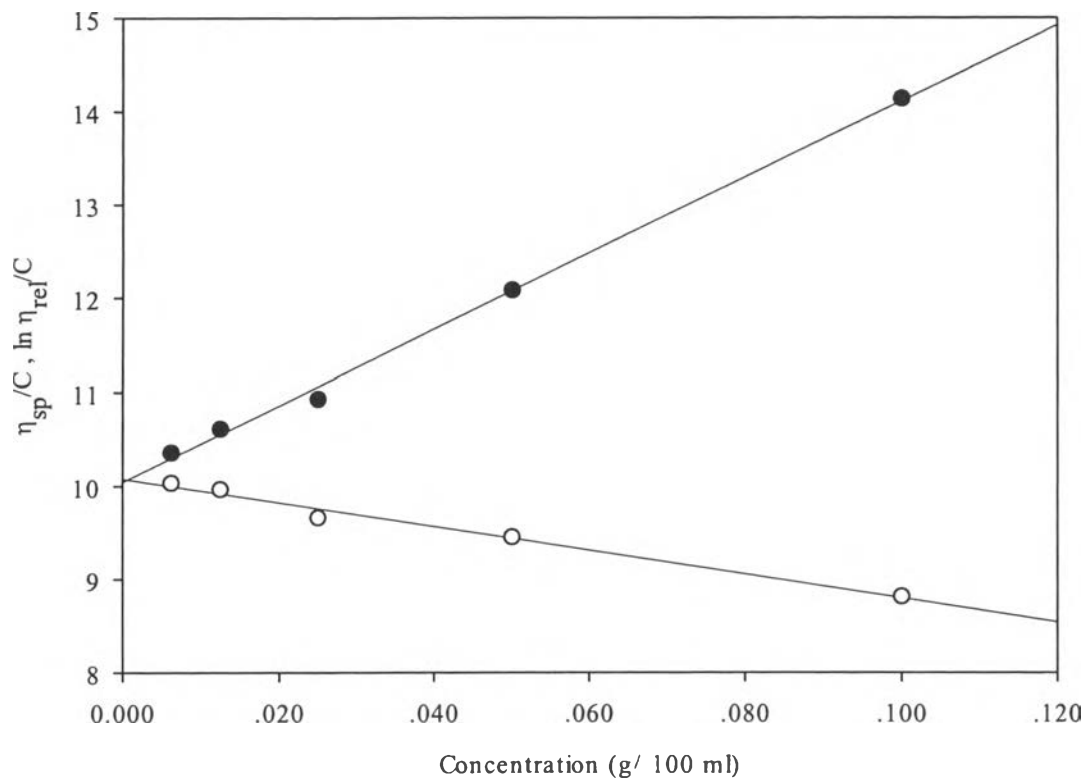


Figure A5 The plot of reduced viscosity (η_{sp}/c) and $\ln((\eta_{rel})/c)$ versus concentration of chitosan solution: • = (η_{sp}/c) and ○ = $\ln((\eta_{rel})/c)$.

$$[\eta] = KM^a = (6.9 \times 10^{-6})M^{1.13}$$

$$\text{intercept} = [\eta] = 10.0645$$

from calculation;

$$M = 284,981$$

Appendix B Mechanical Properties of the Films

Table B1 Tensile strength of the films in dry state

Tensile Strength (MPa)	Film type			
	Alginate	Calcium alginate	Chitosan coated calcium alginate	Chitosan
X 1	75.325	90.532	110.250	65.034
X 2	74.138	96.782	93.597	71.034
X 3	72.692	98.108	120.820	71.153
X 4	73.617	97.649	123.720	65.202
X 5	76.246	92.227	127.290	78.462
Average	74.404	95.059	115.135	70.177
Standard deviation	1.4019	3.4455	13.6153	5.51201

Table B2 Young' s modulus of the films in dry state

Young's modulus (MPa)	Film type			
	Alginate	Calcium alginate	Chitosan coated calcium alginate	Chitosan
X 1	1639.9	2024.1	2156.9	1023.7
X 2	1813.8	2074.5	2157.4	1183.9
X 3	1848.8	2081.2	2189.5	1270.1
X 4	1881.9	2139.5	2208.5	1278.7
X 5	1957.9	2169	2200.3	1340.7
Average	1828.46	2097.66	2182.52	1219.42
Standard deviation	118.103	57.1366	24.1205	122.840

Table B3 Elongation at break of the films in dry state

Elongation at break (%)	Film type			
	Alginate	Calcium alginate	Chitosan coated calcium alginate	Chitosan
X 1	11.495	10.425	8.0469	11.438
X 2	12.897	10.277	9.5068	11.923
X 3	11.559	9.7484	8.4698	13.206
X 4	11.225	10.223	7.1550	12.505
X 5	10.781	9.876	8.3446	15.025
Average	11.5915	10.1099	8.3046	12.819
Standard deviation	0.7913	0.2852	0.8458	1.3986

Table B4 Tensile strength of the films in wet state

Tensile strength (MPa)	Film type	
	Calcium alginate	Chitosan coated calcium alginate
X 1	4.0311	2.2216
X 2	4.1062	2.2114
X 3	4.3557	2.2981
X 4	4.3321	2.6302
X 5	4.4399	2.5329
Average	4.2530	2.3788
Standard deviation	0.175018	0.191177

Table B5 Young's modulus of the films in wet state

Young's modulus (MPa)	Film type	
	Calcium alginate	Chitosan coated calcium alginate
X 1	33.407	14.894
X 2	33.116	16.852
X 3	43.745	15.821
X 4	32.481	14.278
X 5	40.846	14.627
Average	36.719	15.294
Standard deviation	5.20356	1.04190

Table B6 Elongation at break of the films in wet state

Elongation at break (%)	Film type	
	Calcium alginate	Chitosan coated calcium alginate
X 1	37.072	36.256
X 2	39.366	52.944
X 3	36.576	38.262
X 4	40.506	50.748
X 5	40.942	42.788
Average	38.892	44.199
Standard deviation	1.98169	7.41104

Appendix C UV Spectrum of Model Drugs

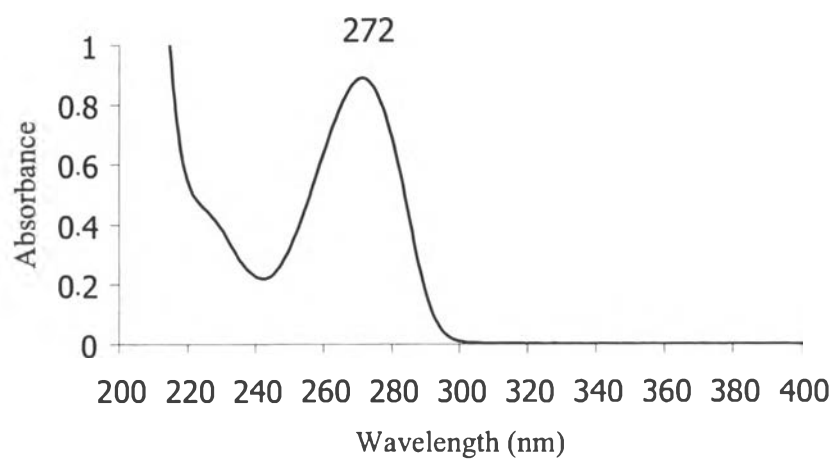


Figure C1 UV spectrum of theophylline.

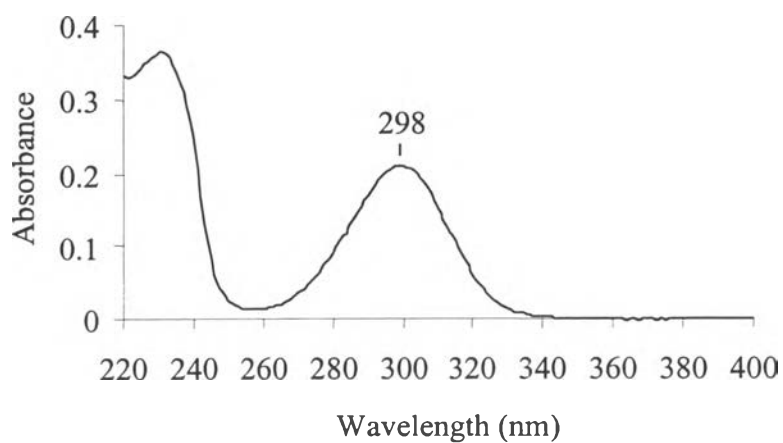


Figure C2 UV spectrum of salicylic acid.

Table C1 Summary of maximum wavelength (λ_{\max}) of each type of model drug

Model drug	λ_{\max} (nm)
Theophylline	272
Salicylic acid	298

Appendix D Calibration Curve of Model Drugs

Table D1 The data of calibration curve of salicylic acid solution

Concentration (mg/100mL)	Absorbance at 298nm (A_{298})			Average	Standard deviation
	X1	X2	X3		
0.0	0.0000	0.0000	0.0000	0.0000	0.0000
0.1	0.0384	0.0413	0.0384	0.039367	0.001674
0.2	0.0586	0.0609	0.0586	0.059367	0.001328
0.3	0.0845	0.0854	0.0845	0.0848	0.00052
0.4	0.1094	0.1151	0.1094	0.1113	0.003291
0.5	0.1376	0.1398	0.1376	0.138333	0.00127
0.6	0.168	0.1694	0.168	0.168467	0.000808
0.7	0.1926	0.1929	0.1926	0.1927	0.000173
0.8	0.2188	0.2231	0.2188	0.220233	0.002483
0.9	0.2429	0.2504	0.2429	0.2454	0.00433
1.0	0.2784	0.2851	0.2784	0.280633	0.003868

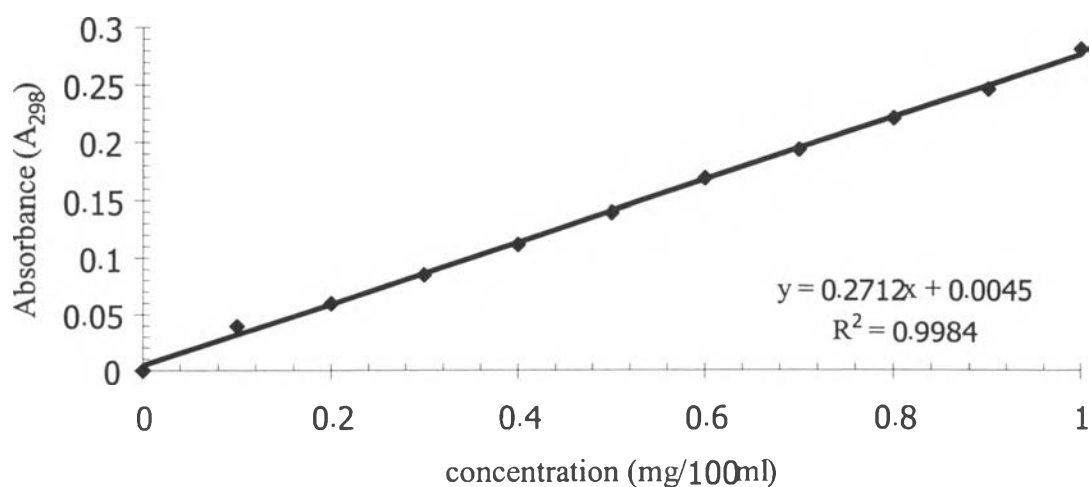
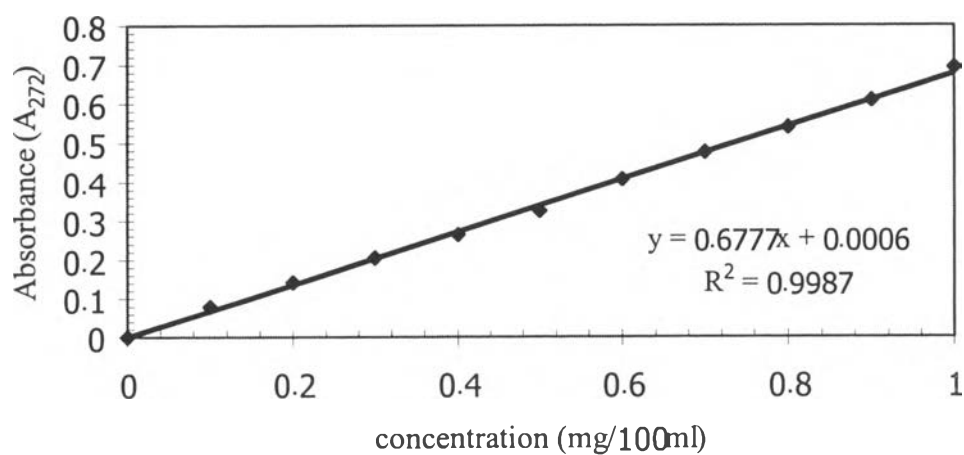


Figure D1 Calibration curve of salicylic acid solution.

Table D2 The data of calibration curve of theophylline solution

Concentration (mg/100mL)	Absorbance at 272nm (A_{272})			Average	Standard deviation
	X1	X2	X3		
0.0	0.0706	0.0896	0.0761	0.078767	0.009777
0.1	0.1402	0.1441	0.1412	0.141833	0.002026
0.2	0.2042	0.2055	0.2028	0.204167	0.00135
0.3	0.2656	0.2624	0.2645	0.264167	0.001626
0.4	0.3249	0.3254	0.324	0.324767	0.000709
0.5	0.4062	0.4058	0.4057	0.4059	0.000265
0.6	0.4699	0.473	0.4841	0.475667	0.007466
0.7	0.5317	0.5475	0.5373	0.538833	0.008011
0.8	0.6084	0.6149	0.601	0.6081	0.006955
0.9	0.6839	0.6907	0.7027	0.692433	0.009519
1.0	0.0706	0.0896	0.0761	0.078767	0.009777

**Figure D2** Calibration curve of theophylline solution.

Appendix E The Data of Drug Release

Table E1 The release of salicylic acid from calcium alginate film at pH 2.0

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	-0.90444	-0.90444	1.76869	-0.01339
1.0	2.23096	3.65798	10.39108	5.42668
2.0	13.86818	11.39602	10.83326	12.03249
3.0	20.82237	16.76241	14.31035	17.29838
4.0	14.69223	23.61611	17.02369	18.44401
5.0	15.07411	20.44049	21.80721	19.10727
6.0	15.63687	27.61577	23.53571	22.26279
7.0	18.75219	30.14822	25.70638	24.86893
8.0	20.84247	31.43455	27.05300	26.44334
9.0	22.59107	32.01741	28.50012	27.70286
10.0	21.72682	32.09781	29.90704	27.91055
15.0	22.51067	32.33899	31.27375	28.70781
20.0	23.23423	31.91692	31.43455	28.86190
25.0	23.73670	32.29879	31.73603	29.25717
30.0	23.81709	32.56008	31.87672	29.41796
40.0	23.97788	32.66057	32.01741	29.55196
50.0	24.03818	32.84146	32.09781	29.65915
60.0	24.15877	32.90176	32.23850	29.76634
90.0	24.23917	32.94196	32.39929	29.86014
120.0	24.27937	32.96206	32.60028	29.94723
150.0	24.52055	33.06255	32.70077	30.09462
180.0	25.72648	33.30374	32.82136	30.61719

Cont.....

Table E1 (Continued)

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
210.0	26.30935	33.68561	32.96206	30.98567
240.0	26.38974	33.98710	33.04245	31.13976
300.0	26.51034	34.56996	33.12285	31.40105
360.0	26.61083	35.17293	33.16304	31.64893
420.0	26.71132	36.17787	33.24344	32.04421
480.0	27.07310	36.78083	33.36403	32.40599

Table E2 The release of salicylic acid from calcium alginate film at pH 5.5

Time (minutes)	Amount of drug release (%)			Average
	X ₁	X ₂	X ₃	
0.0	0.0000	0.0000	0.0000	0.0000
0.5	5.6436	6.1869	10.1425	7.3240
1.0	16.3284	16.0673	23.2374	18.5444
2.0	21.2691	20.5260	33.6811	25.1587
3.0	26.9529	22.4340	40.0679	29.8183
4.0	27.79646	23.09677	43.14075	31.34466
5.0	29.64420	23.83988	46.8764	33.45350
6.0	29.74462	25.20561	47.07724	34.00916
7.0	29.86513	26.51108	47.45884	34.61168
8.0	29.94546	26.89267	47.94086	34.92633
9.0	30.42748	27.13368	48.60364	35.38827
10.0	30.56807	27.27427	48.72414	35.52216
15.0	30.70866	27.69604	48.80448	35.73639
20.0	30.78900	28.05755	48.88482	35.91046
25.0	30.82917	28.57974	48.92498	36.11130
30.0	30.92959	29.12201	49.08566	36.37909
40.0	31.07018	29.74462	49.14591	36.65357
50.0	31.21077	30.40740	49.22625	36.94814
60.0	31.29110	30.50782	49.34675	37.04856
90.0	31.39152	30.72875	49.50742	37.20923
120.0	31.47186	31.23085	49.56768	37.42346
150.0	31.51203	31.5522	50.39113	37.81845
180.0	31.73295	31.91371	50.75264	38.13310
210.0	31.79321	32.41581	50.95348	38.38750

Cont.....

Table E2 (Continued)

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
240.0	31.87354	32.57649	50.99365	38.48123
300.0	31.99405	33.19910	52.21878	39.13731
360.0	32.0543	33.68112	52.49996	39.41179
420.0	32.19489	33.86187	52.60038	39.55238
480.0	33.76145	33.96229	52.84139	40.18838

Table E3 The release of salicylic acid from calcium alginate film at pH 7.2

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	7.66052	6.84996	2.74952	5.75333
1.0	11.04577	7.024793	6.500318	8.190295
2.0	11.31596	9.090909	18.49968	12.96885
3.0	24.92053	25.63573	18.72219	23.09282
4.0	25.90591	34.50413	24.0623	28.15745
5.0	38.63636	37.38080	27.68595	34.56770
6.0	70.08900	61.50668	33.93198	55.17588
7.0	74.84107	66.27463	34.31341	58.47637
8.0	85.44183	73.25175	43.91291	67.53549
9.0	89.66942	76.74825	50.74698	72.38822
10.0	99.74571	85.29879	76.76414	87.26955
15.0	99.77750	99.84107	92.64145	97.42000
20.0	99.79339	99.87285	98.53783	99.40136

Table E4 The release of salicylic acid from chitosan-coated calcium alginate film at pH 2

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	0.25122	1.36777	-1.06072	0.18609
1.0	0.92115	3.51713	2.26101	2.23310
2.0	1.311947	3.76835	2.31684	2.46571
3.0	1.33986	3.90792	3.09842	2.78207
4.0	1.47943	4.18706	3.32173	2.99607
5.0	2.06561	4.38246	4.71742	3.72183
6.0	2.81929	4.43828	4.82908	4.02888
7.0	3.18216	4.57785	5.21987	4.32663
8.0	3.48922	4.63368	5.61066	4.57785
9.0	3.96375	4.77325	5.75023	4.82908
10.0	4.18706	4.82908	6.42016	5.14543
15.0	5.24778	4.88490	6.58764	5.57344
20.0	5.58275	4.99656	6.97844	5.85258
25.0	5.88980	5.02447	7.28549	6.06659
30.0	6.05728	5.08030	7.59254	6.24337
40.0	6.39225	5.19196	7.81585	6.46668
50.0	6.64347	5.33153	7.87168	6.61556
60.0	6.69930	5.38735	7.92751	6.67139
90.0	6.89470	5.52692	7.98333	6.80165
120.0	7.31340	5.61066	8.26247	7.06218
150.0	7.81585	5.72232	8.31830	7.28549
180.0	8.96031	5.80606	8.45787	7.74141

Cont.....

Table E4 (Continued)

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
210.0	9.01614	6.05728	8.56952	7.88098
240.0	9.12780	6.22477	8.65326	8.00194
300.0	9.21154	6.33642	8.70909	8.08568
360.0	9.29528	6.44808	8.87657	8.20664
420.0	9.40694	6.50390	9.18362	8.36482
480.0	9.43485	6.53182	9.51859	8.49509

Table E5 The release of salicylic acid from chitosan-coated calcium alginate film at pH 5.5

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	2.54015	2.81929	6.05728	3.80557
1.0	7.09009	4.01958	7.36923	6.15963
2.0	11.50047	5.24778	13.53818	10.09548
3.0	12.11458	8.03916	16.88783	12.34719
4.0	14.90595	8.09499	17.44610	13.48235
5.0	15.57588	8.54161	18.33935	14.15228
6.0	16.74826	9.79773	18.59057	15.04552
7.0	17.11114	9.96521	18.70222	15.25953
8.0	17.13905	10.35601	19.00928	15.50145
9.0	17.16697	10.57932	19.03719	15.59449
10.0	17.25071	10.91428	19.17676	15.78058
15.0	17.33445	11.41673	19.23259	15.99459
20.0	17.50193	11.80752	19.28841	16.19929
25.0	17.69733	12.61702	19.42798	16.58078
30.0	17.94855	13.09156	19.53964	16.85992
40.0	18.00438	13.67775	19.56755	17.08323
50.0	18.08812	13.73357	19.62338	17.14836
60.0	18.14395	13.81731	19.67921	17.21349
90.0	18.22769	13.95688	20.07	17.41819
120.0	18.36726	14.29185	20.18165	17.61359
150.0	18.53474	14.43142	20.2654	17.74385
180.0	18.61848	14.62681	20.37705	17.87412

Cont.....

Table E5 (Continued)

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
210.0	18.81388	14.85012	20.48871	18.05090
240.0	18.95345	14.96178	20.60036	18.17186
300.0	19.00928	15.12926	20.62827	18.25560
360.0	19.26050	15.32466	21.04698	18.54405
420.0	19.34424	15.65962	21.38195	18.79527
480.0	19.62338	16.02250	22.07979	19.24189

Table E6 The release of salicylic acid from chitosan-coated calcium alginate film at pH 7.2

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	1.07184	1.90100	1.47631	1.48305
1.0	1.53698	3.19530	5.15697	3.29641
2.0	4.63116	4.89406	5.05585	4.86036
3.0	9.26232	13.79237	10.75886	11.27119
4.0	23.51984	17.18991	10.88020	17.19665
5.0	24.67257	19.61672	22.00308	22.09746
6.0	26.55335	30.37557	26.85670	27.92854
7.0	27.56452	31.40697	27.82742	28.93297
8.0	45.50269	32.53948	30.39580	36.14599
9.0	45.54314	44.79487	40.50751	43.61517
10.0	45.64426	45.19934	40.56818	43.80392
15.0	45.66448	45.60381	40.5884	43.95223
20.0	45.82627	45.80604	40.66929	44.10053

Table E7 The release of theophylline from calcium alginate film at pH 2

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	22.5616	7.0797	24.9085	18.1833
1.0	27.8519	15.2745	28.1112	23.7459
2.0	30.4711	30.4452	29.9265	30.2809
3.0	32.0012	32.8699	32.9866	32.6192
4.0	34.2184	34.7500	34.0888	34.3524
5.0	34.8927	35.7744	36.3968	35.6879
6.0	35.3984	36.1115	37.0192	36.1763
7.0	37.0581	37.0321	38.4455	37.5119
8.0	37.2396	37.3433	39.9236	38.1689
9.0	38.0565	37.5767	40.7016	38.7783
10.0	38.1213	37.8749	43.0226	39.6730
15.0	38.8863	38.1213	43.3209	40.1095
20.0	39.0938	38.6011	43.5024	40.3991
25.0	39.7810	39.0679	43.8006	40.8832
30.0	40.1311	39.5217	44.1637	41.2722
40.0	40.7405	40.2219	44.9806	41.9810
50.0	40.8183	40.2478	45.2010	42.0890
60.0	42.0761	40.2997	45.3566	42.5774
90.0	42.3743	40.3775	45.9271	42.8930
120.0	42.5169	41.0388	46.1346	43.2301
150.0	42.7244	41.7000	46.3161	43.5802
180.0	43.2560	42.0112	46.7051	43.9908
210.0	43.5413	42.0372	46.7959	44.1248

Cont.....

Table E7 (Continued)

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
240.0	43.8395	42.0501	47.1848	44.3582
300.0	44.0470	42.0761	47.5479	44.5570
360.0	44.0988	42.1798	47.6905	44.6564
420.0	44.2026	42.2835	47.8332	44.7731
480.0	44.2804	42.4651	48.0536	44.9330

Table E8 The release of theophylline from calcium alginate film at pH 5.5

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	8.0522	14.6002	10.3213	10.9912
1.0	30.7564	34.3221	22.7561	29.2782
2.0	31.2491	40.7016	35.4891	35.8133
3.0	32.0660	43.2949	52.6696	42.6769
4.0	32.1568	47.1589	54.1478	44.4878
5.0	32.8051	48.3648	54.1867	45.1189
6.0	33.1033	48.7408	54.6276	45.4906
7.0	33.2070	49.3113	55.0684	45.8623
8.0	33.6220	49.3762	55.3407	46.1130
9.0	33.7646	49.7911	55.5223	46.3593
10.0	34.1017	50.4135	55.7816	46.7656
15.0	34.3351	50.5302	56.2743	47.0465
20.0	34.5555	50.6210	56.5466	47.2410
25.0	34.6204	50.8284	56.5596	47.3361
30.0	34.6852	51.0229	56.8059	47.5047
40.0	34.7241	51.2952	56.9226	47.6473
50.0	34.7500	51.5416	57.0782	47.7899
60.0	34.8538	51.7101	57.3246	47.9628
90.0	34.8927	52.0991	57.5580	48.1833
120.0	35.0094	52.5530	58.1026	48.5550
150.0	35.5410	52.6437	58.6990	48.9612
180.0	35.5669	52.9160	58.8676	49.1168

Cont.....

Table E8 (Continued)

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
300.0	35.6966	53.6292	59.3474	49.5577
360.0	35.7744	53.8755	59.4511	49.7003
420.0	35.8522	54.1608	59.7104	49.9078
480.0	35.9170	55.1592	59.8012	50.2925

Table E9 The release of theophylline from calcium alginate film at pH 7.2

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	3.2407	2.8840	3.8317	3.3188
1.0	3.3324	2.9349	4.0967	3.4547
2.0	3.4853	3.8012	4.1477	3.8114
3.0	3.5464	3.9031	4.1782	3.8759
4.0	4.2190	4.1578	4.2903	4.2224
5.0	8.5501	6.8176	6.5731	7.3136
6.0	10.6188	8.5093	10.0176	9.7152
7.0	11.5462	9.9972	12.8608	11.4680
8.0	21.8185	12.7589	15.4696	16.6823
9.0	21.2478	22.4197	39.4180	27.6952
10.0	31.7851	35.8512	36.7480	34.7948
15.0	43.4230	37.4002	39.9479	40.2570
20.0	85.4090	81.8423	77.6437	81.6317

Table E10 The release of theophylline from chitosan-coated calcium alginate film at pH 2

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	2.1247	0.6631	2.9097	1.8992
1.0	4.8314	1.5563	5.0344	3.8074
2.0	10.1095	3.7217	8.8238	7.5517
3.0	12.9244	5.3051	10.9621	9.7305
4.0	15.6311	6.5637	11.3410	11.1786
5.0	16.7138	8.5937	13.3440	12.8838
6.0	18.6220	8.5261	13.1410	13.4297
7.0	18.9603	9.0403	13.3846	13.7951
8.0	19.5558	8.6749	13.9124	14.0477
9.0	19.2445	8.7020	13.5605	13.8357
10.0	19.2581	8.8238	13.7906	13.9575
15.0	19.2987	8.8779	13.9394	14.0387
20.0	19.3122	9.1080	13.6011	14.0071
25.0	19.1769	9.0809	13.8582	14.0387
30.0	19.9212	8.7832	13.6823	14.1289
40.0	19.4881	8.4449	14.2372	14.0567
50.0	19.6235	8.8509	13.8853	14.1199
60.0	19.4205	9.2839	14.1018	14.2687
90.0	20.4761	9.4328	15.1033	15.0041
120.0	20.5708	10.0418	15.1168	15.2431
150.0	20.0701	10.7455	15.3604	15.3920
180.0	20.9768	10.7726	15.6852	15.8116
210.0	21.4640	10.8673	15.9830	16.1048

Cont.....

Table E10 (Continued)

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
240.0	22.1813	11.0568	16.0506	16.4296
300.0	22.3166	11.0568	16.8897	16.7544
360.0	24.0489	10.9079	17.1198	17.3589
420.0	23.7918	11.2057	17.3363	17.4446
480.0	23.9000	11.3004	17.4175	17.5393

Table E11 The release of theophylline from chitosan-coated calcium alginate film at pH 5.5

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	2.1727	1.5138	1.7097	1.7987
1.0	4.2030	2.1905	3.7578	3.3838
2.0	6.6072	4.5057	6.1976	5.7702
3.0	8.3169	5.4853	6.4826	6.7616
4.0	9.9376	6.6429	8.0676	8.2160
5.0	10.7212	7.6402	10.5609	9.6407
6.0	11.2376	7.9073	11.8075	10.3175
7.0	11.2733	7.9429	11.9144	10.3769
8.0	11.7363	7.9607	12.1815	10.6262
9.0	11.9322	8.0142	12.4665	10.8043
10.0	16.9188	8.2279	12.6802	12.6090
15.0	17.2037	12.6268	21.1752	17.0019
20.0	17.4709	12.9651	21.3533	17.2631
25.0	18.8600	13.4816	21.5136	17.9517
30.0	19.8929	13.8912	22.2794	18.6879
40.0	20.1601	14.3543	22.3862	18.9669
50.0	20.4806	14.5680	22.4219	19.1568
60.0	20.7300	14.9064	22.5287	19.3883
90.0	21.1752	14.9420	22.6890	19.6021
120.0	21.8342	15.5297	22.7959	20.0532
150.0	22.1369	16.1174	22.8315	20.3619
180.0	22.4575	16.4914	23.0986	20.6825
210.0	22.7959	16.7763	23.1877	20.9199

Cont.....

Table E11 (Continued)

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
240.0	23.4548	16.9188	23.3123	21.2286
300.0	23.8466	17.2572	23.3479	21.4839
360.0	24.5946	17.5421	23.4014	21.8460
420.0	24.6836	18.9847	23.4726	22.3803
480.0	24.9508	19.2162	23.5082	22.5584

Table E12 The release of theophylline from chitosan-coated calcium alginate film at pH 7.2

Time (minutes)	Amount of drug release (%)			Average
	X1	X2	X3	
0.0	0.00000	0.00000	0.00000	0.00000
0.5	1.5541	2.2736	3.5111	2.4462
1.0	4.3025	3.3528	6.2739	4.6431
2.0	4.4320	3.4967	7.1660	5.0316
3.0	4.5471	4.3457	8.1301	5.6743
4.0	8.4467	9.1662	9.7706	9.1278
5.0	8.6626	11.0512	13.2241	10.9793
6.0	14.3033	33.1393	21.0233	22.8220
7.0	36.7799	50.9249	34.2905	40.6651
8.0	55.6879	56.9686	36.8806	49.8457
9.0	56.3354	59.7602	51.9322	56.0093
10.0	60.9977	63.5303	62.0049	62.1776

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