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APPENDICES

Appendix A Chracterization of Chitosan and H-Chitosan

Table A1 Viscosity-average melecular weight of chitosan

Conc. (g/100ml)	Time (sec)				η_{rel}	η_{sp}	η_{sp}/c
	1	2	3	average			
0	122.57	122.54	122.51	122.54	-	-	-
0.0063	128.88	128.99	128.78	128.88	1.0518	0.0518	8.2167
0.0125	134.96	134.86	134.91	134.91	1.1009	0.1009	8.0757
0.0250	148.42	148.58	148.97	148.66	1.2131	0.2131	8.5251
0.0500	177.85	177.89	177.87	177.87	1.4515	0.4515	9.0305
0.1000	242.53	242.54	242.55	242.54	1.9793	0.9793	9.7927

Conc. (g/100 ml)	ln η_{rel}	ln(η_{rel})/c
0.0063	0.0505	8.0752
0.0125	0.0962	7.6936
0.0250	0.1932	7.7281
0.0500	0.3726	7.4523
0.1000	0.6827	6.8273

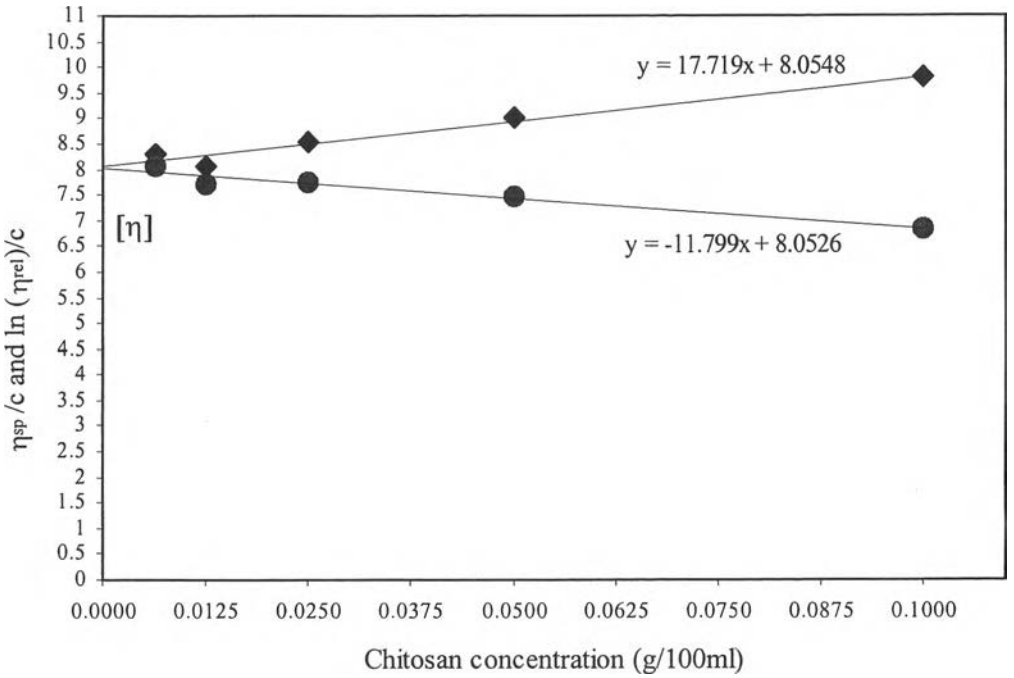


Figure A1 η_{sp}/c and $\ln(\eta_{rel})/c$ against concentration of chitosan solution.

Interception: $[\eta] = 8.0528 \times 10^{-2}$ ml/g

$[\eta] = kM^{a}$

$[\eta] = 8.93 \times 10^{-4} M^{0.71}$

$M = 3.72 \times 10^{5}$ g/mol

Table A2 Degree of substitution of H-chitosan from elemental analysis

H-chitosan	specimens	Experiment values			
		%C	%N	%H	C/N
Repeat reaction	1	65.696	2.395	9.252	
1 time	2	65.710	2.328	9.501	
	average	65.703	2.362	9.377	*27.817*
Repeat reaction	1	66.742	2.217	9.604	
2 times	2	66.374	2.309	9.605	
	average	66.558	2.263	9.605	*29.411*
Repeat reaction	1	66.831	2.289	9.822	
3 times	2	66.774	2.345	9.960	
	average	66.803	2.317	9.891	*28.832*

Calculation of degree of substitution of H-chitosan

Assume: Degree of substitution is four.

(Chitosan was fully substituted with hexanoyl groups.)

molecular weight of

H-chitosan = [(no. of C atoms x 12) +

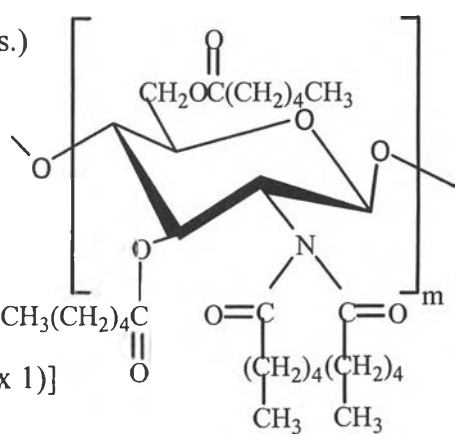
(no. of N atoms x 14) +

(no. of O atoms x 16) +

(no. of H atoms x 1)]

= [(30 x 12) + (14 x 1) + (8 x 16) + (51 x 1)]

= 553



C atoms = (360 x 100)/553 = 65.099%

N atoms = (14 x 100)/553 = 2.532%

H atoms = (16 x 100)/553 = 9.222%

If degree of substitution is four: C/N 25.711

Appendix B Characterization of H-chitosan/PCL Blend Films

Table B1 Thermal properties of H-chitosan/PCL blend films from DSC

H-chitosan/PCL	Glass transition temperature (°C)	Melting temperature (°C)
0/100	-63.5	63.8
20/80	-62.3	63.4
40/60	-63.5	62.8
60/40	-63.4	62.3
80/20	-63.5	61.5
100/0	-	-

Table B2 Decomposition temperatures of H-chitosan/PCL blend films from TGA

H-chitosan/PCL	Decomposition temperature of PCL (°C)	Decomposition temperature of pyranose ring (°C)	Decomposition temperature of hexanoyl groups (°C)
0/100	391.08	-	-
20/80	387.22	319.92	257.66
40/60	387.85	317.18	249.87
60/40	378.07	307.39	246.82
80/20	385.57	314.19	249.27
100/0	-	321.00	255.38

Table B3 Mechanical properties of H-chitosan/PCL blend films

H-chitosan/PCL	specimens	thickness (micron)	load (N)	tensile strength (MPa)	elongation at break (%)
0/100	1	24.70	5.70	8.44	59.15
	2	25.10	7.70	12.47	89.56
	3	21.40	6.80	12.71	57.84
	4	23.40	8.30	14.19	72.30
	5	25.10	8.30	13.23	49.56
			average	12.21	65.68
			STD	2.20	15.64
20/80	1	29.9	7	9.36	156.2
	2	29.9	9.2	12.31	172.9
	3	23.6	4.8	8.14	119.2
	4	21.2	4.7	8.87	79.55
	5	27.4	7.2	10.51	162.9
			average	9.84	138.15
			STD	1.63	38.53
40/60	1	26.30	4.6	7.00	187.60
	2	30.00	4.1	5.47	164.30
	3	25.80	4.2	6.51	172.30
	4	30.00	5	6.67	198.60
	5	25.00	3.4	5.44	118.50
			average	6.22	168.26
			STD	0.72	30.83
50/50	1	28.50	2.80	3.93	77.48
	2	30.00	2.90	3.87	77.48
	3	27.50	3.30	4.80	129.50
	4	27.50	3.00	4.36	97.90
	5	28.50	3.20	4.49	133.50
			average	4.29	103.17
			STD	0.39	27.21

H-chitosan/PCL	specimens	thickness (micron)	load (N)	tensile strength (MPa)	elongation at break (%)
60/40	1	30.00	2.2	2.93	37.00
	2	29.00	2	2.76	32.89
	3	29.80	2	2.68	24.56
	4	25.10	1.6	2.87	28.09
	5	29.00	1.8	2.21	27.88
			average	2.69	30.08
			STD	0.29	4.87
70/30	1	30.00	2.5	3.39	36.22
	2	29.00	2.1	2.80	22.89
	3	29.80	2.2	2.93	24.56
	4	25.10	2.3	3.07	25.88
	5	29.00	2.5	3.33	36.49
			average	3.10	29.21
			STD	0.25	6.61
80/20	1	29.50	2.90	3.93	137.90
	2	29.50	2.20	2.98	69.56
	3	30.00	2.50	3.33	61.22
	4	28.20	2.40	3.40	109.60
	5	29.70	2.70	3.64	106.20
			average	3.46	96.90
			STD	0.35	31.42
100/0	1	30.00	3.50	4.67	366.30
	2	26.30	3.00	4.56	316.20
	3	30.00	2.90	3.87	346.20
	4	28.90	2.50	3.46	367.90
	5	29.80	2.60	3.49	369.60
			average	4.01	353.24
			STD	0.58	22.77

Table B4 Oxygen permeability measurement of H-chitosan/PCL blend films

H-chitosan /PCL	specimens	T (°C)	films thickness average (μm)	N	G (cm^3/ m^2.sec.bar)	$\underline{P}$ (cm^3/μm m^2.sec.bar)
0/100	1	25.6	30.00	1.9818	25179	755379
	2	25.3	29.00	1.8292	27308	791918
	3	24.9	30.00	1.8783	26629	798868
				average	26372	782055
				STD	1087	23362
20/80	1	27.2	30.00	4.6620	10646	319392
	2	26.8	30.00	4.4543	11158	334728
	3	26.8	30.00	4.0917	12147	364399
				average	11317	339506
				STD	763	22881
40/60	1	26.8	30.00	36.3636	1367	41002
	2	26.8	30.00	35.3357	1398	41943
	3	28.0	30.00	29.1545	1698	50937
				average	1488	44628
				STD	183	5484
50/50	1	28.6	27.50	16.1812	3053	83961
	2	27.6	28.50	10.5485	4699	133922
	3	28.0	28.50	9.7276	5089	145030
				average	4280	120971
				STD	1080	32529
80/20	1	25.9	28.50	17.7620	2807	79986
	2	26.3	29.50	14.1643	3515	103683
	3	28.3	27.50	12.2699	4032	110872
				average	3451	98180
				STD	615	16162

H-chitosan /PCL	specimens	T (°C)	films thickness average (μm)	N	G (cm^3/ m^2.sec.bar)	$\underline{P}$ (cm^3/μm m^2.sec.bar)
100/0	1	25.9	27.50	4.7281	10543	289937
	2	28.0	27.50	11.6550	4247	116799
	3	28.0	27.50	8.9686	5519	151784
				average	6770	186173
				STD	3329	91548

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