REFERENCES

Ameer, G.A., Mahmood, T.A., and Langer, R. (2002). A biodegradable composite scaffold for cell transplantatation. Journal of Orthopedic Research, 20, 16-19.

Bostman, O.M. (1991). Absorbable implants for the fixation of fractures. Journal of Bone Surgery, 73(1), 148-153.

Cao, Y., Vacanti, J.P. Paige, K.T., Upton, J., and Vacanti, C.A. (1997). Transplantation of chondroycytes utilizing a polymer-cell construct to produce tissue-engineering cartilage in the shape of a human ear. Plastic Reconstruction Surgery, 100, 297-302.

Chen, G., Ushida ,T., and Tateishi, T. (2001). Preparation of poly(L-lactic acid) and poly(DL-lactic-co-glycolic acid) foams by use of ice microparticulates. Biomaterials, 22, 2563-2567.

Chen, G., Ushida, T., and Tateishi, T. (2001). Development of biodegradable porous scaffolds for tissue engineering. Materials Science and Engineering C 17, 63-69.

Chen, L., Du, Y., Wu, H., and Xiao, L. (2002). Relationship between molecular structure and moisture-retention ability of carboxymethyl chitin and chitosan. Journal of Applied Polymer Science, 83, 1223-1241.

Chen, X.G., Wang, Z., Liu, W.S., and Park, H.J. (2002). The effect of carboxymethyl-chitosan on proliferation and collagen secretion of normal and keloid skin fitroblasts. Biomaterials, 23, 4609-4614.

Cima, L.G., Vacanti, J.P., Ingber, D., Mooney, D., and Langer, R. (1991). Tissue engineering by cell transplantation using degradable polymer substitutes, Journal of Biomedical Engineering, 113, 143-151.

Cooper, M.L., Honsbrough, J.F., Spielvogel, R.L., Cohen, R., Bartel, R.L., and Naughton, G. (1991). *In vivo* optimization of a living dermal substitute employing cultured human fibroblasts on a biodegradable polyglycolic acid or polyglactin mesh. Biomaterials, 12, 243-248.

Cusick, R.A., Lee, H., Sano, K., Pollok, J.M., Utsunomiya, H., Ma, P.X., Langer, R., and Vacanti, J.P. (1997). The effect of donor and recipient age on

engraftment of tissue-engineered liver. Journal of Pediatric Surgery, 32, 357-360.

David, N. and Hon, S. (Eds.). (1996). Chitin and Chitosan : medical applications. Polysaccharides in Medical Applications. New York: Marcel Dekker.

Elein, A.E., Elein, Y.M., and Peppas, G.D. (1998). Neural tissue engineering: adrenal chromaffin cell attachments and viability on chitosan scaffolds. Neurological Research, 20, 648-654.

Francis, S.J.K. and Matthew, H.W.T. (2000). Application of chitosan-based polysaccharide biomaterials in cartilage tissue engineering: a review. Biomaterials, 21, 2589-2598.

Gingras, M., Paradis, I., and Berthod, F. (2003). Nerve regenation in a collagen-chitosan tissue-engineered skin transplanted on nude mice. Biomaterials, 24, 2003, 1653-1661.

Guan, Y., Liu, X., Zhang, Y., and Yao, K. (1998). Study of phase behavior on chitosan/viscose rayon blend film. Journal of Applied Polymer Science, 67, 1965-1972.

Hirano, S., Zhang, M., Nakagawa, M., and Miyata, T. (2000). Wet spun chiotsan-collagen fibers, their chemical N-modifications, and blood compatibility. Biomaterials, 21, 997-1033.

Hjerde, R.J.N., Varum, K.M., Grasdalen, H., Tokura, S., and Smidsrod, O. (1997). Chemical composition of O-(carboxymethyl)-chitins in relation to lyzozyme degradation rates. Carbohydrate Polymers, 34, 131-139.

Hollinger, J.O., and Battisan, G.C. (1986). Biodegradable bone repair materials: synthethic polymers and ceramics. Clinic Orthopedics and Related Research, 207, 290-305.

Hutmacher, D.W. (2000). Scaffold in tissue engineering bone and cartilage. Biomaterials, 21, 2529-2543.

Ishaug, S.L., Crane, G.M., Miller, M.J., Yasko, A.W., Yaszemski, M.J., and Mikos, A.G. (1997). Bone formation by three-dimensional stromal osteoblast culture in biodegradable polymer scaffolds. Journal of Biomedical Material Research, 36, 17-28.

Janvikul, W. and Thavornyutikarn, B. (2003). New route to the preparation of Carboxymethylchitosan hydrogels. Journal of Applied Polymer Science, 90, 4016-4020.

Kaneko, M., Inoue, Y., and Tokura, D. (1982). Report in Progress. Polymer Physics Japan, XXV, 759.

Kang, H.W., Tabata, Y., and Ikada, Y. (1999). Fabrication of porous gelatin scaffolds for tissue engineering. Biomaterials, 20, 1339-1344.

Khor, E., Wan, ACA., Tee, CF., and Hastings, GW. (1997). Reversible water-swellable chitin gel. Journal of Polymer Science Part B-Polymer Physics, 35, 2049-2053.

Kim, S.D., Kim, S.H., and Lee, L.M. (1996). Preparation, characterization, and properties of β-chitin and N-deacetylated β-chitin. Journal of Polymer Science: Part B: Polymer Physics, 34, 2367-2374.

Kittur, F.S., Prashanth, K.V.H., Udaya Sankar, K., and Tharanthan, R.N. (2002). Characterization of chitin, chitosan and their carboxymethyl derivatives by differential scanning calorimetry. Carbohydrate Polymers, 49, 185-193.

Kojima, K., Okamoto, Y., Miyatake, K., Kitamura, Y., and Minami, S. (1998). Collagen typing of granulation tissue induced by chitin and chitosan. Carbohydrate Polymers, 37,109-113.

Korey, D.J. and Schwartz, J.B. (1989). Effect of excipients on the crystallization of pharamaceutical compounds during lyophilization. Journal of Parenterial Science and Technology, 43(2), 80-87.

Krause, T.J., Zazanis, G., Malatesta, P., and Solina, A. (2001). Prevention of pericardial Adhesions with N-O Carboxymethyl chitosan in the rabbit model. Journal of Investigative Surgery, 14, 93-97.

Langer, R. and Vacanti, J.P. (1993). Tissue engineering. Science, 260, 920-926.

Lee, J.Y., Nam, S.H., Im, S.Y., Park, Y.J., Lee, Y.M., Seol, Y.J., Chung, C.P., and Lee, S.J. (2002). Enhanced bone formation by controlled growth factor delivery from chitosan-based biomaterials. Journal of Controlled Release, 78, 187-197.

Lee, V.F. (1974). Ph.D. Thesis, University Microfilm, Ann Arbor, Michigan.

Li, J., Pan, P., Zhang, L., and Yu, Y. (2003). Culture of hepatocytes on fructose-modified chitosan scaffolds. Biomaterials, 24, 2317-2322.

Li, Z., Liu, X., Zhuang, X., Guan, Y., and Yao, K. (2002). Manufacture and properties of chitosan/N,O-carboxymethylated chitosan/viscose rayon antibacterial fibers. Journal of Applied Polymer Science, 84, 2049-2059.

Li, Z., Zhuang X.P., Liu, X.F., Guan L.Y., and Yao, D.K. (2002). Study on antibacterial O-carboxymethylated chitosan/cellulose blend film from LiCl/N,N-dimethylacetamide solution. Polymer, 43, 1541-1547.

Lim, L.Y., Khor, E., and Ling, C.E. (1999). Effects of dry heat and saturated steam on the physical properties of chitosan. Journal of Biomaterial Research, 48(2), 111-116.

Lin, V.S., Lee, M.C., O'Neal, S., Mackean, J., and Sung, K.L.P. (1999). Ligament tissue engineering using synthetic biodegradable fiber scaffolds. Tissue Engineering, 5, 443-451.

Ma, J., Wang, H., He, B., and Chen, J. (2001). A preliminary in vitro study on the fabrication and tissue engineering applications of a novel chitosan bilayer material as a scaffold of human neofetal dermal fibroblasts. Biomaterials, 22, 331-336.

Ma, X.H ., Noishiki, Y., Iwai, Y., Marato, D., and Matsumoto, A. (1996). Thermal crosslinking for biologically degradable materials preliminary report. Journal of ASAIO, 42, 866-871.

Madihally, S.V. and Matthew, H.W. (1999). Porous chitosan scaffolds for tissue engineering. Biomaterials, 20(1), 1133-1142.

Mao, J.S., Zhao, L.G., Yin, Y.J., Yao, K.D. (2003). Structure and properties of bilayer chitosan-gelatin scaffolds. Biomaterials, 24, 1067-1074.

Muramatsu, K., Masuda, S., Yoshihara, Y., and Fujisawa, A. (2003). *In vitro* degradation behavior of freeze-dried carboxymethyl-chitin sponges processed by vacuum-heating and gamma irradiation. Polymer Degradation and Stability, 81, 327-332.

Murphy, W.L., Kohn, D.H., and Mooney, D.J. (2000). Growth of continuous bonelike mineral within porous poly (lactide-glycolide) scaffold *in vitro*. Journal of Biomedical Material Research, 42, 417-424.

Muzzarelli, R.A.A. (1988). Carboxymethylated chitins and chitosans. Carbohydrate Polymer, 8, 1-21.

Nishinmura, S., Ikeuchi, S.Y., and Tokura, S. (1984). The adsorption of bovine blood proteins onto the surface of O-carboxymethyl-chitin. Carbohydrate Research, 134, 305-312.

Nishinmura, S., Nishi, N., and Tokura, S. (1986). Bioactive chitin derivative activation of mouse-peritoneal macrophages by O-carboxymethyl-chitin. Carbohydrate Research, 146, 251-258.

Oberpenning, F., Meng, J., Yoo, J.J., and Atala, A. (1999). De novo reconstitution of a functional mammalian urinary bladder by tissue engineering. Natural Biotechnology, 17, 149-155.

Osborne, C.S., Reid, W.H., and Grant, M.H. (1999). Investigation into the biological stability of collagen/chondroitin-6-sulfate gels and their contraction by fibroblasts and keratinocytes: the effect of crosslinking agents and diamines. Biomaterials, 20, 283-290.

Park, S.N., Park, J.C., Kim, H.O., Song, M.J., and Suh, H. (2002). Characterization of porous collagen/hyaluronic acid scaffold modified by 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide cross-linking. Biomaterials, 23, 1205-1212.

Peluso, G., Petillp, O., Raniem, M., Santin, M., Ambtosio, L., Calabro, D., Avallone, B., and Balsamo, G. (1994). Chitosan-mediated stimulation of macrophage function, Biomaterials, 15, 1215-1220.

Rizzi, G.P. (1994). The Maillard reaction in foods. Labuza, T.P., Reineccius, G.A., Monnier, V.M., O'Brian, J., and Baynes, J.W. (1989). Maillard reactions in chemistry, food and health. London: The Royal Society of Chemistry, 11-19.

Rocha, L.B., Goissis,G., and Rossi, M.A. (2002). Biocompatibility of anionic collagen matrix as scaffold for bone healing. Biomaterials, 23, 449-456.

Sannan, T., Kurita, K., Ogura, K., and Iwakura, T. (1978). Studies on chitin: 7.IR spectroscopic determination of degree of deacetylation. Polymer, 19, 458-462.

Shanmugasundaram, N., Ravichadran, P., Neelakanta, R.P., Ramammurty, N., Pal, S., and Panduranga, R.K. (2001). Collagen-chitosan polymeric scaffolds for the in vitro culture of human epidermoid carcinoma cells. Biomaterials, 1943-1951.

Shapiro, L. and Cohen, S. (1997). Novel alginate sponges for cell culture and transplantation. Biomaterials, 18, 583-590.

Sun, T., Xu, P., Liu, Q., Xue, J., and Xie, W. (2003). Graft copolymerization of methacrylic acid onto carboxymethyl chitosan. European Polymer Journal, 39, 189-192.

Tang, L.G. and Hon, D.N.S. (2001). Chelation of chitosan derivatives with Zinc ions II. Association complexes of Zn^{2+} onto O,N-carboxymethylchitosan. Journal of Applied Polymer Science, 79, 1476-1485.

Taravel , M.N. and Domard, A. (1995). Collagen and its activation with chitosan II. Influence of the physiochemical characteristics of collagen. Biomaterials, 16, 865-871.

Taravel , M.N. and Domard, A. (1996). Collagen and its interactions with chitosan, III. Some biological and mechanical properties. Biomaterials, 17, 451-455.

Thacharodi, D. and Rao, P.K. (1995). Collagen-chitosan composite membranes for controlled release of propranolol hydrochloride. International Journal of Pharmaceutics, 120, 115-118.

Thacharodi, D. and Rao, K.P. (1996). Collagen-chitosan composite membranes controlled transdermal delivery of nifedipine and propranolol hydrochoride. International Journal of Pharmaceutics, 134, 239-241.

Thanou, M., Verhoef, J.C., and Junginger .H.E. (2001). Oral drug absorption enhancement by chitosan and its derivatives. Advanced Drug Delivery Reviews, 52, 117-126.

Tokura, S., Nishi, N., Takahashi, K, Shirai, A., and Uraki,Y. (1995). Novel drug-delivery system by chitin derivative. Macromolecule Symposia, 99, 201-208.

Tokura, S., and Tamura, H. (2001). O-carboxymethyl-Chitin concentration in Granulocytes during Bone Repair. Biomacromolecules, 2, 417-421.

Travel, M.N. and Domard A. (1995). Collagen and its interaction with chitosan, II. Influence of the physiochemical characteristics of collagen. Biomaterials, 16(11), 865-871.

Usami, Y., Okamoto, Y., Minami, S., Matsuhashi, A., Kumazawa, N., Tanioka, S., and Shigemasa, Y. (1994). Chitin and chitosan induce migration of bovine polymorphonuclear cells. Journal of Veterinarian Medical Science, 56, 761-762.

Vacanti, C.A., Langer, R., Scholco, B., and Vacanti, J.P. (1990). Synthetic biodegradable polymers seeded with chondroycyte provide a template for new cartilage formation *in vitro*. Journal of Pediatric Surgery, 23, 140-145.

Vacanti, J.P. (1993). Commentary.Cell Transplant, 2, 409-410.

Wang, H., Li, W., Lu, Y., and Wang, Z. (1997). Studies on chitosan and poly(acrylic acid) interpolymer complex.I. Preparation, structure, pH-structure, and salt sensitivity of complex-forming poly(acrylic acid): chitosan semiinterpenetrating polymer network. Journal of Applied Polymer Science, 65, 1445-1450.

Weadock, K.S., Miller, E.J., Bellincampi, L.D., Zawadsky, J.P., and Dunn, M.G. (1995). Physical crosslinking of collagen fibers: comparison of ultraviolet irradiation and dehydrothermal treatment. Journal of Biomedical Material Research, 29, 1373-1379.

Whang, K., Thomas, H., and Hearly, K.E. (1995). A novel method to fabricate bioabsorbable scaffolds. Polymer, 36, 837-842.

Widmer, M.S., Gupta, P.K., and Lu, L. (1998). Manufacture of porous biodegradable polymer scaffold conduits by an extrusion process for guided tissue regeneration. Biomaterials, 19, 1945-1955.

Xie, W., Xu, P., Wang, W., and Liu, Q. (2002). Preparation of water- soluble chitosan derivatives and their antibacterial activity. Journal of Applied Polymer Science, 85, 1357-1361.

Yannas, I.V., Burke, J.F., Warpehoski, M., Stasikelis, P., Skrabut, E.M., Orgill, D.P., and Giard, D.J. (1981). Prompt, long-term functional replacement of skin. Transaction American Society Artificial International Organs, 27, 19-22.

Yannas, I.V. (1988). Degeneration of skin and nerve by use of collagen templates. In: Nimni, editor. Collagen-III. Boca Raton, FL:CRC Press, 87-115.

Yannas, I.V. (1990). Biologically active analogous of the extracellular matrix: artificial skin and nerves. Angew Chemistry International of England, 29, 20-35.

Zacchi, V., Soranza, C., Cartivo, R., Radice, M., Boon, P., and Abatangelo, G. (1998). In vitro engineering of human skin-like tissue. Journal of Biomedical Material Research, 40, 187-194.

Zeeman, R., Dijkstra, P.J., Van Wachem, P.B., Van, Luyn, M.J.A., Hendriks, M., Cahalan, P.T., Feijen, T.(1999). Successive epoxy and carbodiimde cross-linking of dermal sheep collagen. Biomaterials, 20, 921-931.

Zhang, L., Guo, J., Zhou, J., Yang, G., and Du, Y. (2000). Blends membranes from carboxymethylated chitosan/alginated in aqueous solution. Journal of Applied Polymer Science, 77, 610-616.

Zhao, F., Yin, Y., Lu, W.W., Chiang, L.J.C., Zhang, W., Zhang, J., Zhang, M., and Yao, K. (2002). Preparation and histological evaluation of biomimetic three-dimensional hydroxyapatite/chitosan-gelatin network composite scaffolds. Biomaterials, 23, 3227-3234.

Zhao, L., Mitomo, H., Nagasawa, N., Yoshi, F., and Kume, T. (2003). Radiation synthesis and characteristic of the hydrogels based on carboxymethylated chitin derivatives. Carbohydrate Polymers, 51, 169-175.

Zong, Z., Kimura, Y., Takahashi, M., and Yamane, H. (2000). Characterization of chemical and solid state structure of acylated chitosan. Polymer, 41, 899-906.

APPENDICES

Appendix A Characterization of Chitin

Table A1 Viscosity-average molecular weight of chitin

Time (sec)	Conc.(g/100 ml)					
	0	0.01	0.02	0.03	0.04	0.05
X1	352.00	406.69	459.10	516.08	581.02	640.17
X2	352.00	406.57	459.36	516.17	597.09	640.03
X3	352.00	406.93	459.78	516.04	597.02	641.71
Average	352.00	406.73	459.41	516.10	591.74	640.64
ηrel		1.1555	1.3052	1.4662	1.6811	1.9120
ηsp		0.1555	0.3052	0.4662	0.6811	0.9120
η_{sp}/C		15.55	15.26	15.54	17.03	16.40
$\ln(\eta_{rel})/C$		14.45	13.32	12.76	12.99	11.98

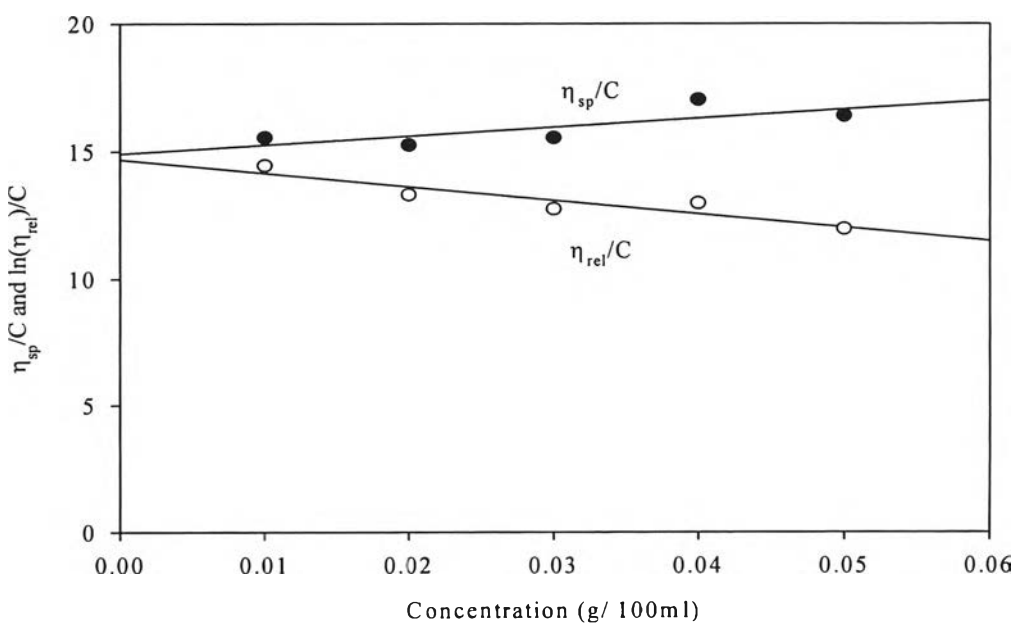


Figure A1 η_{sp}/c and $\ln(\eta_{rel})/C$ against concentration of chitin solution.

The viscosity-average molecular weight of chitin was determined based on Mark-Houwink equation. The K and a values were according to Lee *et al.*, (1974).

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

Where $[\eta]$ = intrinsic viscosity

M = Viscosity-average molecular weight

Interception: $[\eta] = 14.80$

From calculation; $M = 8.71 \times 10^5$

The viscosity-average molecular weight of chitin obtained from calculation was 8.71×10^5 g/mol.

Appendix B Characterization of Chitosan

Table B1 Viscosity-average molecular weight of chitosan (I) (treatment 1)

Time (sec)	Conc.(g/100 ml)					
	0	0.01	0.02	0.03	0.04	0.05
X1	214.90	247.28	283.68	326.18	371.32	570.72
X2	214.31	247.25	283.31	326.44	371.47	570.25
X3	241.72	247.31	283.09	326.62	371.72	570.81
Average	241.64	247.28	283.36	326.41	371.50	570.59
ηrel		1.1521	1.3202	1.5207	1.7308	1.9120
ηsp		0.1521	0.3202	0.5207	0.7308	0.9120
η_{sp}/C		15.21	16.01	17.36	18.27	18.24
$\ln(\eta_{rel})/C$		14.16	13.89	13.97	13.71	12.96

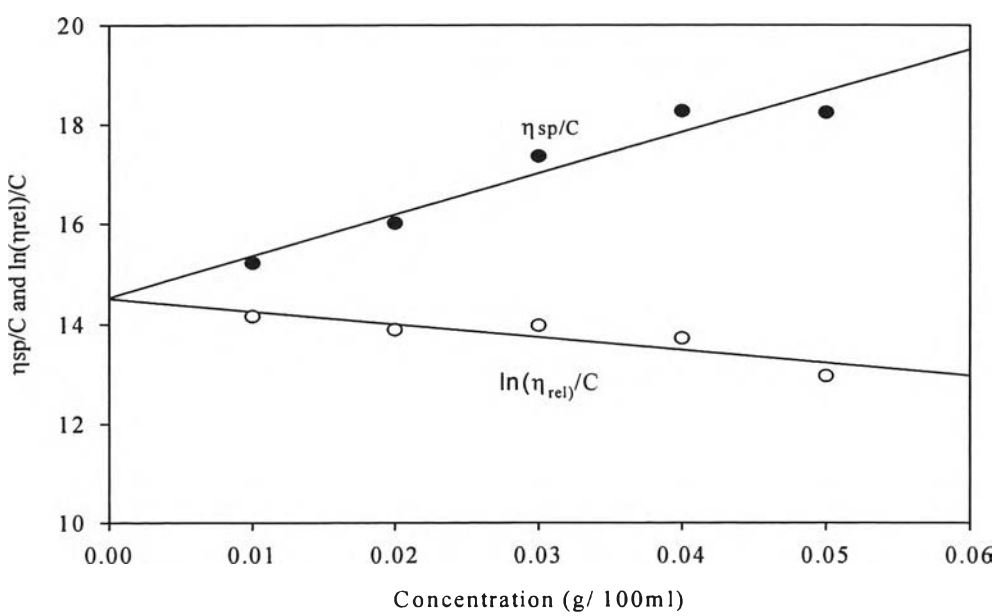


Figure B1 η_{sp}/c and $\ln(\eta_{rel})/C$ against concentration of chitosan (I) solution (treatment 1).

The viscosity-average molecular weight of chitosan was determined based on Mark-Houwink equation. The K and a values were according to Lee *et al.*, (1974).

$$[\eta] = 7.92x10^{-5}M^{1}$$

Where $[\eta]$ = intrinsic viscosity

M = Viscosity-average molecular weight

Interception: $[\eta] = 14.51$

From calculation; $M = 1.83 \times 10^{5}$

The viscosity-average molecular weight of chitosan (I) (treatment 1) obtained from calculation was 1.83×10^{5} g/mol.

Table B2 Viscosity-average molecular weight of chitosan (I) (treatment 2)

Time (sec)	Conc.(g/100 ml)					
	0	0.01	0.02	0.03	0.04	0.05
X1	213.19	242.91	272.91	304.25	342.03	379.35
X2	213.81	242.72	272.47	304.06	342.22	379.39
X3	213.13	242.41	272.13	304.28	342.08	379.25
Average	213.38	242.68	272.50	304.20	342.11	379.33
ηrel		1.1373	1.2771	1.4256	1.6033	1.7777
ηsp		0. 1373	0. 2771	0. 4256	0. 6033	0. 7777
η_{sp}/C		13.73	13.85	14.19	15.08	15.55
$\ln(\eta_{rel})/C$		12.87	12.23	11.82	11.80	11.51

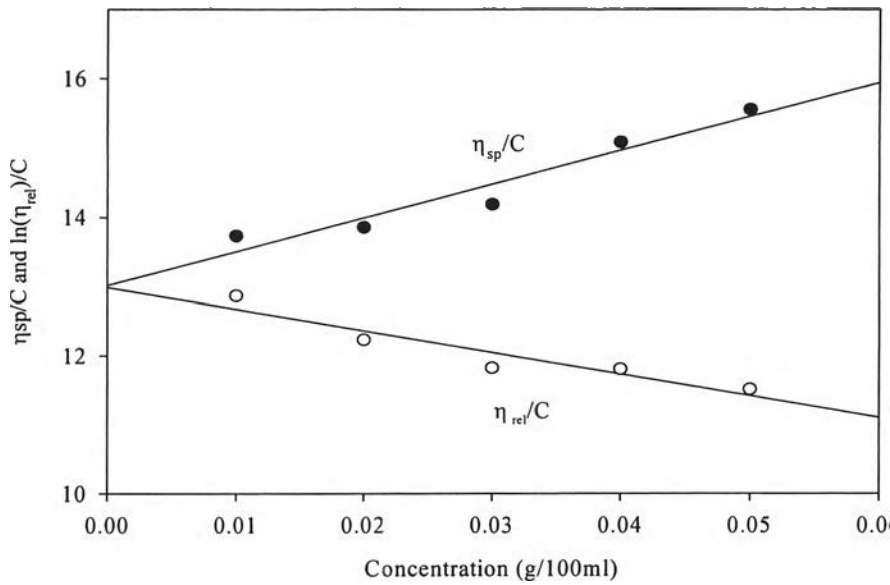


Figure B2 η_{sp}/c and $\ln(\eta_{rel})/C$ against concentration of chitosan (I) solution (treatment 2).

Interception: $[\eta] = 13.00$

From calculation; $M = 1.64 \times 10^5$

The viscosity-average molecular weight of chitosan (I) (treatment 2) obtained from calculation was 1.64×10^5 g/mol.

Table B3 Viscosity-average molecular weight of chitosan (I) (treatment 3)

Time (sec)	Conc.(g/100 ml)					
	0	0.01	0.02	0.03	0.04	0.05
X1	215.59	241.22	271.59	303.53	335.53	371.60
X2	215.18	241.38	271.06	303.46	335.13	371.72
X3	215.16	241.47	271.50	303.82	335.75	371.50
Average	215.31	241.36	271.38	303.60	335.47	371.61
ηrel		1.1210	1.2604	1.4101	1.5581	1.7259

Cont.....

Table B3 (Continued)

	Conc.(g/100 ml)				
	0.01	0.02	0.03	0.04	0.05
ηsp	0. 1210	0. 2604	0. 4101	0. 5581	0. 7259
η_{sp}/C	12.10	13.02	13.67	13.95	14.52
$\ln(\eta_{rel})/C$	11.42	11.57	11.45	11.08	11.92

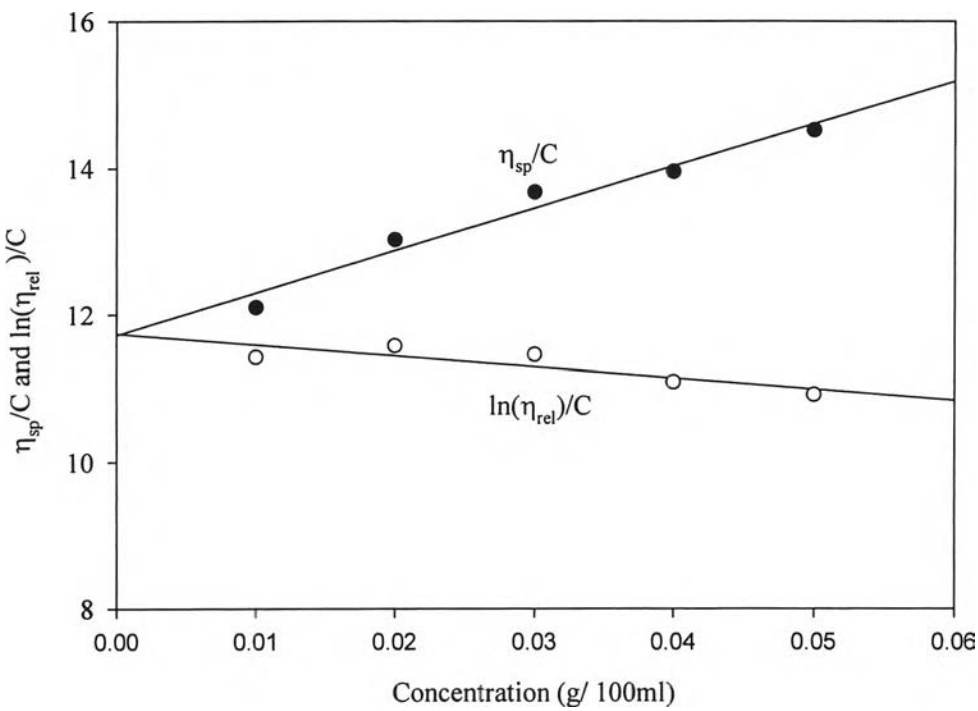


Figure B3 η_{sp}/c and $\ln(\eta_{rel})/C$ against concentration of chitosan (I) solution (treatment 3).

Interception: $[\eta] = 11.73$

From calculation; $M = 1.61 \times 10^5$

The viscosity-average molecular weight of chitosan (treatment 3) obtained from calculation was 1.61×10^5 g/mol.

Table B4 Viscosity-average molecular weight of chitosan (treatment 4)

Time (sec)	Conc.(g/100 ml)					
	0	0.01	0.02	0.03	0.04	0.05
X1	215.06	238.50	266.15	293.47	323.06	355.35
X2	215.69	238.03	266.03	293.53	323.07	355.59
X3	215.16	238.16	266.84	293.67	323.53	355.31
Average	215.30	238.23	266.34	293.56	323.22	354.08
ηrel		1.1065	1.2371	1.3635	1.5013	1.6447
ηsp		0. 1065	0. 2371	0. 3635	0. 5013	0. 6447
η_{sp}/C		10.65	11.85	12.11	12.53	12.89
$\ln(\eta_{rel})/C$		10.12	10.63	10.33	10.16	9.95

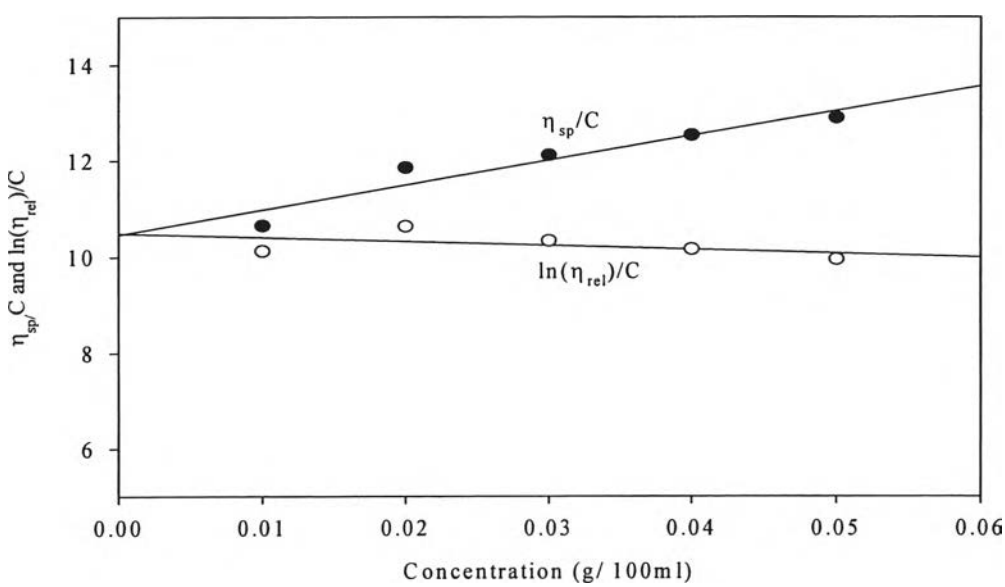


Figure B4 η_{sp}/c and $\ln(\eta_{rel})/C$ against concentration of chitosan (I) solution (treatment 4).

Interception: $[\eta] = 10.46$

From calculation; $M = 1.32 \times 10^5$

The viscosity-average molecular weight of chitosan (I) (treatment 4) obtained from calculation was 1.32×10^5 g/mol.

Table B5 Viscosity-average molecular weight of chitosan (I) (treatment 5)

Time (sec)	Conc.(g/100 ml)					
	0	0.01	0.02	0.03	0.04	0.05
X1	215.06	234.09	255.18	279.66	304.56	330.88
X2	215.69	234.03	255.82	279.81	304.91	330.59
X3	215.16	234.15	255.38	279.09	304.72	330.30
Average	215.30	234.09	255.46	279.52	304.73	330.59
ηrel		1.0872	1.1865	1.2983	1.4154	1.5355
ηsp		0.0872	0.1865	0. 2983	0.4154	0.5355
η_{sp}/C		8.73	9.33	9.94	10.38	10.71
$\ln(\eta_{rel})/C$		8.37	8.55	8.70	8.68	8.57

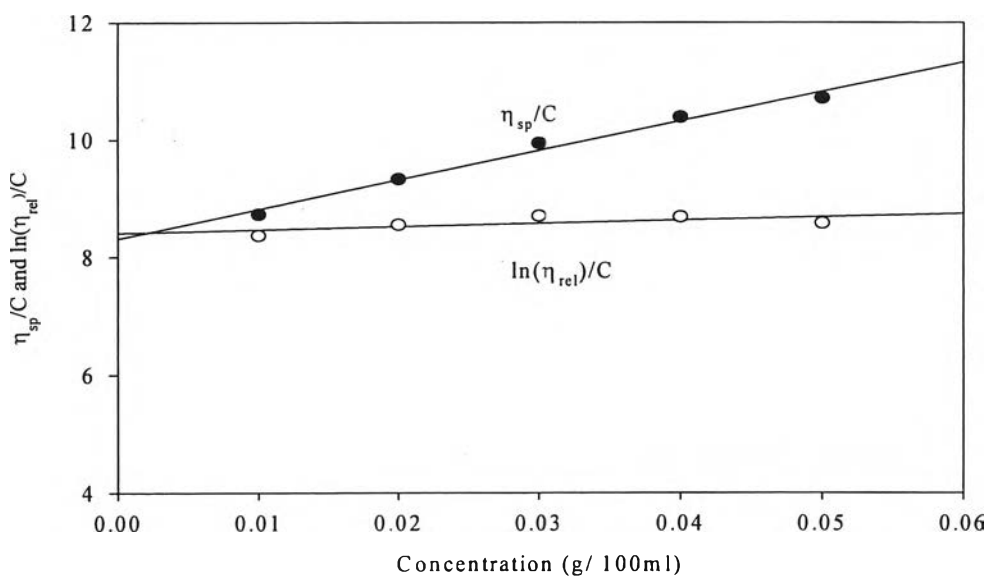


Figure B5 η_{sp}/c and $\ln(\eta_{rel})/C$ against concentration of chitosan (I) solution (treatment 5).

Interception: $[\eta] = 8.36$

From calculation; $M = 1.06 \times 10^5$

The viscosity-average molecular weight of chitosan (I) (treatment 5) obtained from calculation was 1.06×10^5 g/mol.

Table B6 Viscosity-average molecular weight of chitosan (II)

Time (sec)	Conc.(g/100 ml)					
	0	0.01	0.02	0.03	0.04	0.05
X1	237.91	247.00	257.43	267.85	278.35	289.80
X2	237.78	247.74	257.44	267.88	278.23	289.47
X3	237.48	247.79	257.54	267.12	278.68	289.08
Average	237.72	247.51	257.47	267.62	278.42	289.45
ηrel		1.0412	1.0831	1.1258	1.1712	1.2177
ηsp		0. 0412	0. 0831	0. 1258	0. 1712	0. 2177
η_{sp}/C		4.12	4.15	4.19	4.28	4.35
$\ln(\eta_{rel})/C$		4.03	3.99	3.95	3.95	3.93

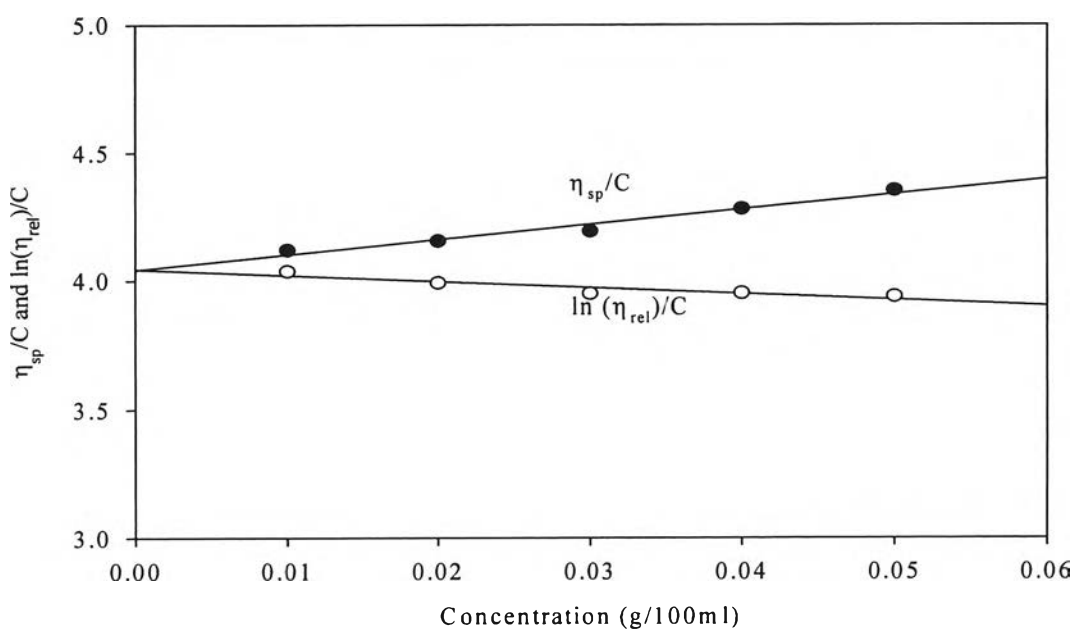


Figure B6 η_{sp}/c and $\ln(\eta_{rel})/C$ against concentration of chitosan (II) solution.

Interception: $[\eta] = 4.04$

From calculation; $M = 5.54 \times 10^5$

The viscosity-average molecular weight of chitosan (II) obtained from calculation was 5.54×10^5 g/mol.

Appendix C Characterization of CM-chitin

Table C1 Viscosity-average molecular weight of CM-chitin

Time (sec)	Conc.(g/100 ml)					
	0	0.01	0.02	0.03	0.04	0.05
X1	228.28	246.10	264.72	286.22	309.10	331.65
X2	228.98	246.06	264.62	286.28	309.00	331.59
X3	228.15	246.25	264.81	286.38	309.00	331.35
Average	228.47	246.14	264.72	286.29	309.03	331.53
ηrel		1.0773	1.1587	1.2531	1.3526	1.4511
ηsp		0. 0773	0. 1587	0. 2531	0. 3526	0. 4511
η_{sp}/C		7.73	7.93	8.44	8.82	9.02
$\ln(\eta_{rel})/C$		7.45	7.36	7.52	7.55	7.45

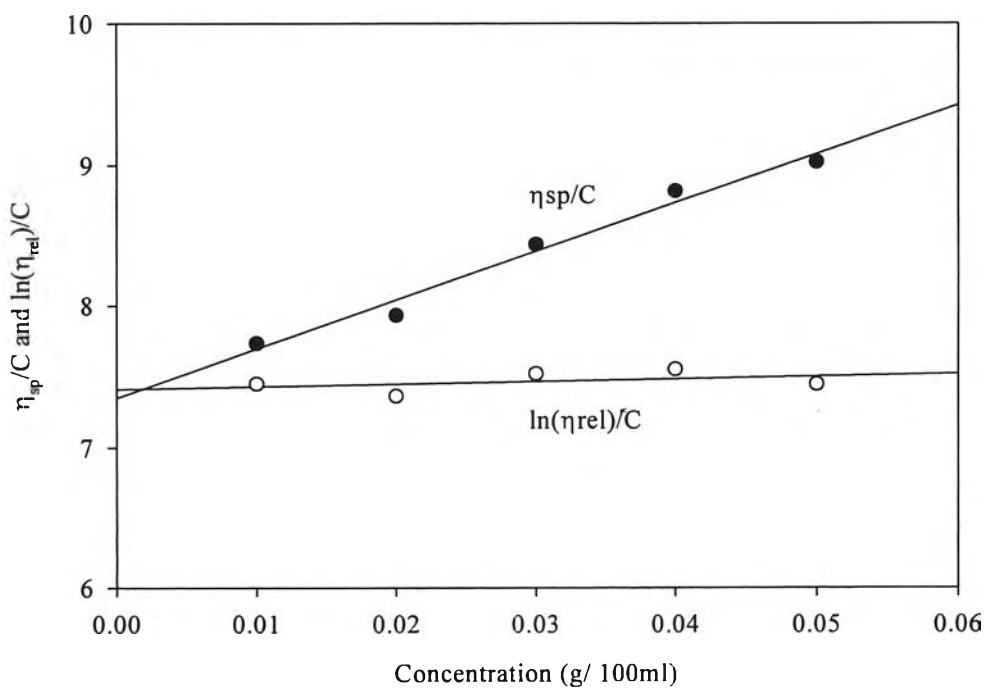


Figure C1 η_{sp}/c and $\ln(\eta_{rel})/C$ against concentration of CM-chitin solution.

The viscosity-average molecular weight of CM-chitin was determined based on Mark-Houwink equation. The K and a values were according to Kaneko *et al.*, (1982).

$$[\eta] = 7.92 \times 10^{-5} M^{1}$$

Where $[\eta]$ = intrinsic viscosity

M = Viscosity-average molecular weight

Interception: $[\eta] = 7.38$

From calculation; $M = 9.32 \times 10^{5}$

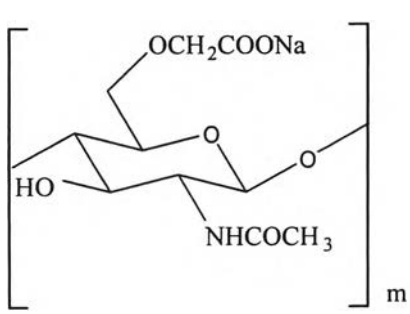
The viscosity-average molecular weight of CM-chitin obtained from calculation was 9.32×10^{5} g/mol.

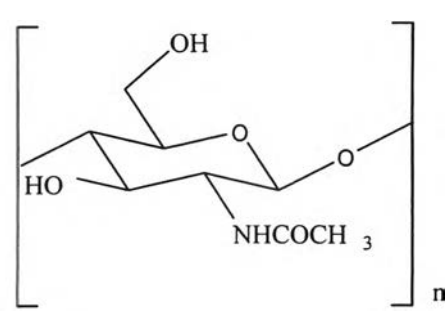
Table C2 Degree of substitution of CM-chitin from elemental analysis

Experimental values

	%C	%H	%N
1	37.892	5.878	5.496
2	37.809	6.289	5.474
Average	37.851	5.881	5.485

Calculation of Degree of Substitution of CM-chitin





MW = $C_{10}H_{14}O_7NNa$ = 283 MW = $C_8H_{13}O_5N$ = 203

$$283\,m + 203\,n = 9.32 \times 10^4 \quad \text{——(1)}$$

From EA, %C = 37.851

%H = 5.881

%N = 5.485

We can find that in CM-chitin structure has N.

That: $$N = \frac{9.32 \times 10^4 \times 5.485}{100} = 5112.02$$

Thus, $14\,m + 14\,n = 5112.02$ ——(2)

Divide (2) by 14 $m + n = 365.144$

$m = 365.144 - n$ ——(3)

Replace (3) in (1), $283(365.144) - 283\,n + 203\,n = 9.32 \times 10^4$

$80\,n = 10135.75$

$n = 126.67$

$m = 238.45$

Therefore, fraction m = 238.45/365.144 = 0.65

n = 126.67/365.144 = 0.35

The degree of carboxymethylation was estimated to be 0.65.

Appendix D Characterization of CM-chitosan

Table D1 Viscosity-average molecular weight of CM-chitosan

Time (sec)	Conc.(g/100 ml)					
	0	0.01	0.02	0.03	0.04	0.05
X1	228.10	236.10	244.16	253.44	263.53	273.00
X2	228.28	236.11	244.37	253.23	263.06	273.23
X3	228.69	235.53	244.00	253.25	263.92	273.19
Average	228.36	235.91	244.18	253.31	263.50	273.14
ηrel		1.0331	1.0693	1.1092	1.1539	1.1961
ηsp		0. 0331	0. 0693	0. 1092	0. 1539	0. 1961
η_{sp}/C		3.31	3.46	3.64	3.84	3.92
$\ln(\eta_{rel})/C$		3.25	3.35	3.46	3.58	3.58

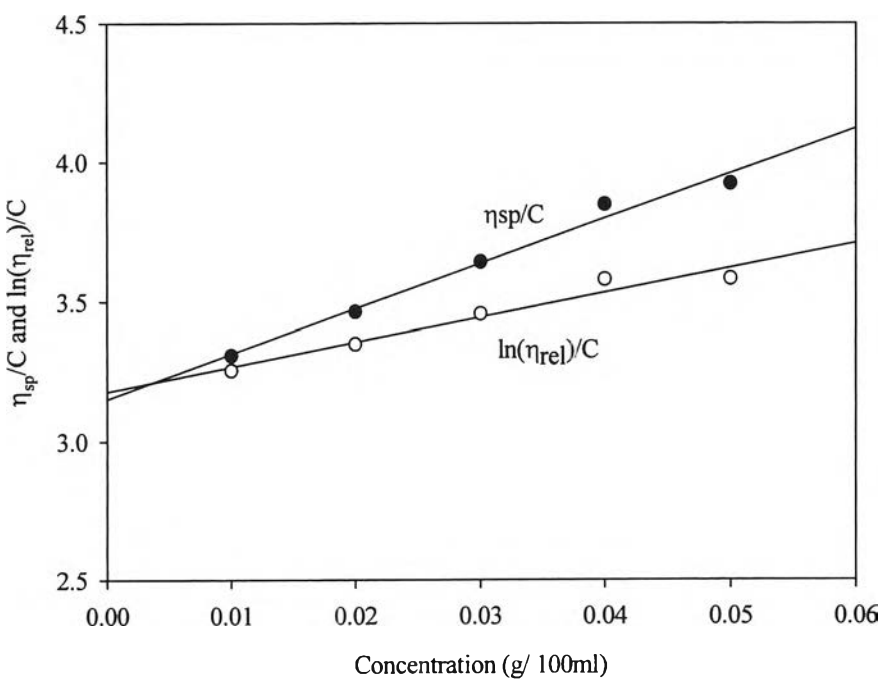


Figure D1 η_{sp}/c and $\ln(\eta_{rel})/C$ against concentration of CM-chitosan solution.

The viscosity-average molecular weight of CM-chitin was determined based on Mark-Houwink equation. The K and a values were according to Kaneko *et al.*, (1982).

$$[\eta] = 7.92x10^{-5}M^{1}$$

Where $[\eta]$ = intrinsic viscosity

M = Viscosity-average molecular weight

Interception: $[\eta] = 3.17$

From calculation; $M = 4 \times 10^{4}$

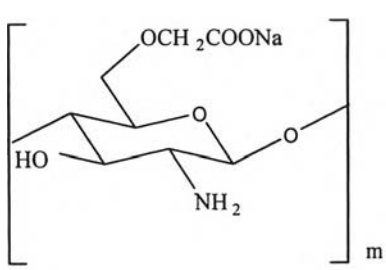
The viscosity-average molecular weight of CM-chitosan obtained from calculation was 4×10^{4} g/mol.

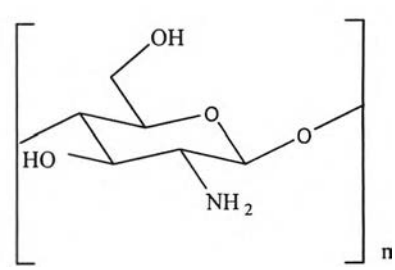
Table D2 Degree of substitution of CM-chitosan from elemental analysis

Experimental values

	%C	%H	%N
1	36.069	5.902	5.956
2	37.074	5.760	5.974
Average	37.072	5.831	5.965

Calculation of Degree of Substitution of CM-chitosan





MW = $C_8H_{12}O_6NNa$ = 241 MW = $C_6H_{11}O_4N$ = 161

$$241\,m + 161\,n = 3.997 \times 10^4 \quad \text{—— (1)}$$

From EA, %C = 37.072

%H = 5.831

%N = 5.965

We can find that in CM-chitin structure has N.

That: $$N = \frac{3.997 \times 10^4 \times 5.965}{100} = 2384.21$$

Thus, $14\,m + 14\,n = 2384.21$ ——(2)

Divide (2) by 14 $m + n = 170.301$

$m = 170.301 - n$ ——(3)

Replace (3) in (1), $241(170.301) - 241\,n + 161\,n = 3.997 \times 10^4$

$80\,n = 1072.54$

$n = 13.41$

$m = 156.89$

Therefore, fraction m = 156.89/170.30 = 0.92

n = 13.41/170.30 = 0.08

The degree of carboxymethylation was estimated to be 0.92.

Appendix E Weight Loss

Table E1 Weight loss of steamed 6% chitosan (I) scaffold in water

Temp (^{0}C)	EWC (%)			Average	Standard deviation
	X1	X2	X3		
110	17.56	14.94	16.26	16.25	1.31
115	14.18	15.23	13.77	14.39	0.75
121	13.68	14.05	14.11	13.95	0.24

Table E2 Weight loss of steamed 2.5% chitosan (I) scaffold in water

Temp (^{0}C)	EWC (%)			Average	Standard deviation
	X1	X2	X3		
110	29.16	29.00	29.98	29.37	0.53
115	25.63	24.68	24.47	24.93	0.62
121	18.86	19.27	16.05	18.06	1.75

Table E3 Weight loss of steamed 2.5% chitosan (II) scaffold in water

Temp (^{0}C)	EWC (%)			Average	Standard deviation
	X1	X2	X3		
110	28.78	29.64	30.33	29.58	0.78
115	24.67	26.75	26.91	26.11	1.25
121	21.17	20.87	18.55	20.20	1.44

Table E4 Weight loss of steamed 2% CM-chitin scaffold in water

Temp (^{0}C)	EWC (%)			Average	Standard deviation
	X1	X2	X3		
110	33.49	34.18	35.04	34.23	0.78
115	30.77	30.04	31.68	30.83	0.82
121	12.99	12.85	12.32	12.72	0.35

Table E5 Weight loss of steamed 3% CM-chitosan scaffold in water

Temp (^{0}C)	EWC (%)			Average	Standard deviation
	X1	X2	X3		
110	20.37	20.35	22.54	21.09	1.26
115	16.21	16.01	17.52	16.58	0.82
121	15.04	14.39	14.03	14.49	0.51

Table E6 Weight loss of steamed 2.5% CM-chitosan scaffold in water

Temp (^{0}C)	EWC (%)			Average	Standard deviation
	X1	X2	X3		
110	24.03	24.22	24.20	24.15	0.11
115	17.88	19.23	19.31	18.80	0.81
121	15.87	14.93	14.14	14.99	0.87

Table E7 Weight loss of steamed 6% chitosan (I) scaffold in 0.2 M acetic acid

Temp (^{0}C)	EWC (%)			Average	Standard deviation
	X1	X2	X3		
110	13.45	12.88	13.41	13.24	0.32
115	12.77	12.09	11.27	12.04	0.75
121	7.93	7.86	9.48	8.42	0.91

Table E8 Weight loss of steamed 2.5% chitosan (I) scaffold in 0.2 M acetic acid

Temp (^{0}C)	EWC (%)			Average	Standard deviation
	X1	X2	X3		
110	19.34	20.27	17.84	19.15	1.23
115	14.23	13.99	15.00	14.40	0.53
121	10.83	9.47	11.09	10.46	0.87

Table E9 Weight loss of steamed 2.5% chitosan (II) scaffold in 0.2 M acetic acid

Temp (^{0}C)	EWC (%)			Average	Standard deviation
	X1	X2	X3		
110	17.68	18.34	19.07	18.36	0.70
115	17.42	17.09	16.45	16.99	0.49
121	11.04	10.81	10.09	10.65	0.49

Appendix F Degree of swelling

Table F1 Degree of swelling of steamed 6% chitosan (I) scaffold at 110^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0	0.00
2	10.85	11.03	11.37	11.09	0.27
5	10.99	11.32	11.57	11.30	0.29
10	11.03	11.44	11.78	11.42	0.37
15	11.15	11.39	11.84	11.46	0.35
20	11.17	11.34	11.89	11.46	0.38
25	11.19	11.37	11.73	11.43	0.27
30	11.07	11.35	11.57	11.33	0.25
35	11.19	11.50	11.72	11.47	0.26
40	11.15	11.28	11.73	11.39	0.30
45	11.13	11.41	11.58	11.37	0.23
50	11.25	11.20	11.78	11.41	0.32
55	11.13	11.54	11.85	11.51	0.36
60	11.17	11.56	11.77	11.50	0.30

Table F2 Degree of swelling of steamed 6% chitosan (I) scaffold at 115^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0	0.00
2	10.10	9.41	9.77	9.76	0.34
5	10.20	9.71	10.51	10.14	0.40
10	10.30	9.98	10.85	10.38	0.44
15	10.35	10.16	10.69	10.40	0.27
20	10.33	9.95	10.81	10.36	0.43
25	10.44	9.83	10.85	10.37	0.52
30	10.53	9.83	10.66	10.34	0.45
35	10.72	10.01	10.73	10.49	0.41
40	10.87	9.80	10.76	10.48	0.59

Cont.....

Table F2 (Continued)

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
45	10.57	9.94	10.85	10.46	0.47
50	10.71	9.90	10.74	10.45	0.48
55	11.11	10.07	10.84	10.67	0.54
60	10.68	9.99	10.74	10.47	0.42

Table F3 Degree of swelling of steamed 6% chitosan (I) scaffold at 121^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0	0.00
2	9.23	9.32	9.03	9.19	0.15
5	9.61	9.85	9.50	9.66	0.18
10	9.83	9.89	9.61	9.78	0.15
15	9.63	9.90	9.78	9.77	0.14
20	9.59	9.66	9.62	9.62	0.03
25	9.61	9.51	9.64	9.59	0.07
30	9.52	9.46	9.89	9.62	0.24
35	9.54	9.95	9.75	9.75	0.21
40	9.63	9.51	9.65	9.60	0.08
45	9.72	10.07	9.54	9.78	0.27
50	9.34	9.49	9.73	9.52	0.20
55	9.34	9.93	9.45	9.57	0.32
60	9.29	10.28	9.45	9.68	0.53

Table F4 Degree of swelling of steamed 2.5% chitosan (I) scaffold at 110^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0	0.00	0.00	0	0.00
2	14.00	14.13	13.91	14.01	0.11

Cont.....

Table F4 (Continued)

Time (minutes)	Degree of Swelling (%)			Average	Standard
	X1	X2	X3		
5	14.57	14.57	14.09	14.41	0.28
10	14.74	14.85	14.12	14.57	0.40
15	14.31	15.09	14.41	14.60	0.43
20	14.76	14.83	14.71	14.77	0.06
25	15.06	15.02	14.46	14.85	0.33
30	15.19	14.82	14.62	14.88	0.29
35	14.47	14.67	15.28	14.81	0.42
40	15.00	15.06	14.32	14.79	0.41
45	14.27	14.32	15.17	14.58	0.51
50	14.72	14.60	14.62	14.65	0.07
55	14.33	15.63	15.23	15.06	0.66
60	15.03	14.73	14.65	14.80	0.20

Table F5 Degree of swelling of steamed 2.5% chitosan (I) scaffold at 115^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0	0.00
2	13.74	13.77	13.04	13.52	0.41
5	13.85	13.95	13.99	13.93	0.07
10	14.12	14.19	14.32	14.21	0.10
15	14.03	14.14	14.20	14.12	0.08
20	14.00	14.02	14.52	14.18	0.30
25	14.04	14.14	14.30	14.16	0.13
30	13.71	14.11	14.01	13.94	0.21
35	13.97	14.08	14.42	14.16	0.24
40	13.99	13.84	14.11	13.98	0.14
45	14.13	13.96	13.92	14.00	0.11
50	13.61	14.14	13.85	13.87	0.27
55	14.11	14.10	14.12	14.11	0.01
60	14.08	14.03	14.21	14.11	0.09

Table F6 Degree of swelling of steamed 2.5% chitosan (I) scaffold at 121^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0	0.00
2	13.68	13.77	11.70	13.05	1.17
5	12.79	14.68	11.72	13.06	1.50
10	14.00	14.65	11.82	13.49	1.49
15	13.73	14.64	11.95	13.44	1.37
20	13.79	14.48	11.93	13.40	1.32
25	13.82	14.41	11.95	13.39	1.28
30	13.78	14.39	12.04	13.41	1.22
35	13.76	14.69	11.90	13.45	1.42
40	14.02	14.62	11.85	13.50	1.46
45	13.57	14.40	12.02	13.33	1.21
50	13.65	14.36	11.82	13.28	1.31
55	13.63	14.51	11.81	13.32	1.38
60	13.73	14.44	12.04	13.41	1.23

Table F7 Degree of swelling of steamed 2.5% chitosan (II) scaffold at 110^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0	0.00
2	16.04	14.75	15.97	15.59	0.73
5	17.08	15.13	17.01	16.41	1.10
10	17.09	15.41	17.02	16.51	0.95
15	17.09	17.18	17.96	17.41	0.48
20	17.11	17.37	17.93	17.47	0.42
25	17.13	17.33	17.92	17.46	0.41
30	17.11	17.78	17.96	17.62	0.45
35	17.13	17.79	17.98	17.63	0.45
40	17.15	17.57	18.01	17.58	0.43
45	17.12	18.39	17.93	17.81	0.64
50	17.29	19.06	17.37	17.91	1.00

Cont.....

Table F7 (Continued)

Time (minutes)	Degree of Swelling (%)			Average	Standard
	X1	X2	X3		
55	17.31	19.51	17.02	17.95	1.36
60	17.37	19.72	16.89	17.99	1.51

Table F8 Degree of swelling of steamed 2.5% chitosan (II) scaffold at 115^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0	0.00
2	15.77	14.09	16.24	15.37	1.13
5	16.01	14.62	16.52	15.72	0.99
10	16.02	14.02	16.56	15.53	1.34
15	16.57	14.29	16.40	15.75	1.27
20	16.83	14.51	16.76	16.03	1.32
25	17.10	14.32	16.38	15.93	1.45
30	16.80	14.33	16.40	15.84	1.33
35	16.90	14.56	16.36	15.94	1.23
40	16.78	14.57	16.38	15.91	1.18
45	16.83	14.37	16.35	15.85	1.30
50	16.93	14.46	16.49	15.96	1.32
55	16.85	14.54	16.50	15.96	1.24
60	16.88	14.27	16.39	15.85	1.39

Table F9 Degree of swelling of steamed 2.5% chitosan (II) scaffold at 121^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0	0.00
2	13.94	14.34	13.92	14.07	0.24
5	14.35	14.64	14.38	14.46	0.16
10	14.37	14.66	14.85	14.63	0.24

Cont.....

Table F9 (Continued)

Time (minutes)	Degree of Swelling (%)			Average	Standard
	X1	X2	X3		
15	14.38	14.68	15.23	14.77	0.43
20	14.32	14.71	15.40	14.81	0.54
25	14.39	15.08	15.19	14.89	0.44
30	14.37	15.02	15.22	14.87	0.44
35	14.38	15.11	15.23	14.91	0.46
40	14.39	14.74	15.37	14.83	0.50
45	14.33	14.62	15.94	14.96	0.86
50	14.35	14.68	15.79	14.94	0.75
55	14.39	14.69	15.38	14.82	0.51
60	14.36	14.72	15.56	14.88	0.61

Table F10 Degree of swelling of steamed 2% CM-chitin scaffold at 110^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0.00	0.00
2	32.03	31.13	28.62	30.59	1.77
5	32.78	32.08	29.29	31.38	1.85
10	35.34	34.94	30.30	33.53	2.80
15	34.13	35.08	34.07	34.43	0.56
20	35.80	36.58	37.50	36.62	0.85
25	36.08	36.63	36.23	36.31	0.29
30	35.30	36.87	38.98	37.05	1.85
35	38.05	37.13	36.96	37.38	0.59
40	36.48	37.35	40.00	37.94	1.84
45	37.45	36.60	39.49	37.85	1.49
50	36.84	36.87	38.41	37.37	0.89
55	37.39	37.30	37.59	37.43	0.15
60	37.66	37.69	37.49	37.61	0.11

Table F11 Degree of swelling of steamed 2% CM-chitin scaffold at 115^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0.00	0.00
2	28.63	28.98	27.23	28.28	0.93
5	29.49	29.93	28.33	29.25	0.83
10	30.64	29.54	28.34	29.51	1.15
15	30.18	30.35	29.13	29.89	0.66
20	29.43	32.94	29.06	30.48	2.14
25	30.73	32.11	28.25	30.36	1.96
30	29.63	30.29	31.62	30.51	1.01
35	29.74	33.60	29.20	30.84	2.40
40	29.90	34.11	29.69	31.23	2.49
45	29.18	35.24	31.53	31.98	3.05
50	31.68	31.73	30.70	31.37	0.58
55	31.34	31.38	30.27	31.00	0.63
60	30.26	30.54	32.59	31.13	1.27

Table F12 Degree of swelling of steamed 2% CM-chitin scaffold at 121^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0.00	0.00
2	23.75	24.14	22.57	23.48	0.82
5	24.56	25.93	23.43	24.64	1.25
10	25.07	25.65	24.23	24.98	0.71
15	24.87	25.96	24.00	24.94	0.98
20	25.09	26.96	24.46	25.50	1.30
25	25.21	26.98	23.18	25.12	1.90
30	25.36	27.39	23.29	25.34	2.05
35	25.85	26.84	24.45	25.71	1.20
40	24.44	27.40	23.70	25.18	1.96
45	25.66	26.41	24.55	25.54	0.93

Cont.....

Table F12 (Continued)

Time (minutes)	Degree of Swelling (%)			Average	Standard
	X1	X2	X3		
50	24.99	27.46	23.14	25.20	2.17
55	25.36	27.45	24.22	25.68	1.64
60	25.50	26.78	22.96	25.08	1.94

Table F13 Degree of swelling of steamed 3% CM-chitosan scaffold at 110^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0.00	0.00
2	21.18	20.38	19.21	20.26	0.99
5	22.74	20.83	19.36	20.98	1.70
10	22.42	21.22	21.25	21.63	0.68
15	22.59	21.79	19.02	21.14	1.88
20	22.63	22.18	20.01	21.61	1.40
25	22.33	22.73	20.51	21.86	1.19
30	21.35	22.95	21.59	21.96	0.87
35	20.58	22.09	23.56	22.08	1.49
40	23.17	22.69	20.23	22.03	1.58
45	22.55	22.30	21.84	22.23	0.36
50	22.80	22.44	22.81	22.68	0.21
55	22.84	22.84	20.52	22.07	1.34
60	22.80	22.57	20.98	22.12	0.99

Table F14 Degree of swelling of steamed 3% CM-chitosan scaffold at 115^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0.00	0.00
2	19.20	20.42	20.21	20.21	0.93
5	18.65	20.77	19.84	19.84	1.08
10	19.70	21.09	20.70	20.70	0.87

Cont.....

Table F14 (Continued)

Time (minutes)	Degree of Swelling (%)			Average	Standard
	X1	X2	X3		
15	19.43	20.97	20.68	20.68	1.14
20	19.62	20.93	20.65	20.65	0.92
25	20.31	20.69	20.50	20.50	0.19
30	19.63	20.98	20.69	20.69	0.96
35	20.10	20.67	20.93	20.93	0.99
40	19.24	20.86	20.94	20.94	1.74
45	20.02	21.10	21.05	21.05	1.01
50	19.31	20.95	20.87	20.87	1.52
55	19.30	20.67	20.50	20.50	1.12
60	20.59	20.72	20.84	20.84	0.34

Table F15 Degree of swelling of steamed 3% CM-chitosan scaffold at 121^{O}C for 15 minutes

Time (minutes)	Degree of Swelling (%)			Average	Standard deviation
	X1	X2	X3		
0	0.00	0.00	0.00	0.00	0.00
2	17.78	17.93	16.51	17.40	0.78
5	18.63	19.11	16.96	18.23	1.13
10	18.82	19.31	17.68	18.60	0.84
15	18.86	19.36	17.61	18.61	0.90
20	18.63	19.44	17.61	18.56	0.92
25	18.65	19.29	17.97	18.64	0.66
30	18.87	19.37	18.27	18.84	0.55
35	18.63	19.29	18.59	18.84	0.40
40	18.95	19.52	18.38	18.95	0.57
45	18.64	19.72	18.53	18.97	0.66
50	18.97	19.77	18.66	19.13	0.57
55	19.19	19.79	18.71	19.23	0.54
60	19.24	19.63	18.76	19.21	0.43

Appendix G Mechanical Properties of Scaffolds

Table G1 Tensile strength of non-steamed scaffolds

Tensile strength (MPa)	Type of polymer scaffolds				
	6% chitosan	2.5% chitosan (I)	2.5% chitosan (II)	2% CM-chitin	3% CM-chitosan
X1	0.22	0.07	0.07	0.14	0.18
X2	0.24	0.09	0.08	0.16	0.20
X3	0.25	0.08	0.07	0.13	0.17
X4	0.23	0.07	0.09	0.15	0.17
X5	0.24	0.09	0.08	0.14	0.15
X6	0.24	0.08	0.07	0.15	0.20
X7	0.25	0.07	0.08	0.15	0.18
X8	0.26	0.07	0.08	0.14	0.17
Average	0.24	0.08	0.08	0.15	0.18
Standard Deviation	0.01	0.01	0.01	0.01	0.02

Table G2 Tensile strength of steamed scaffolds at 121°C for 15 minutes

Tensile strength (MPa)	Type of polymer scaffolds		
	6% chitosan	2% CM-chitin	3% CM-chitosan
X1	0.07	0.11	0.09
X2	0.05	0.12	0.09
X3	0.07	0.10	0.07
X4	0.05	0.11	0.07
X5	0.07	0.09	0.08
X6	0.07	0.09	0.07
X7	0.07	0.08	0.07
X8	0.07	0.10	0.06
Average	0.06	0.10	0.07
Standard Deviation	0.01	0.01	0.01

Table G3 Elongation at break of non-steamed scaffolds

Elongation at break (%)	Type of polymer scaffolds				
	6% chitosan	2.5% chitosan (I)	2.5% chitosan (II)	2% CM-chitin	3% CM-chitosan
X1	15.62	9.71	11.52	12.60	12.64
X2	16.75	8.62	11.13	13.13	14.09
X3	15.15	9.82	13.74	14.85	13.55
X4	16.46	11.50	12.92	12.97	15.48
X5	15.13	7.71	12.91	11.09	12.69
X6	16.83	7.69	11.52	16.00	13.28
X7	16.17	8.45	12.17	12.09	16.00
X8	18.50	9.06	13.02	14.35	15.07
Average	16.33	9.07	12.37	13.39	14.10
Standard Deviation	1.10	1.26	0.92	1.59	1.28

Table G4 Elongation at break of steamed scaffolds at 121°C for 15 minutes

Elongation at break (%)	Type of polymer scaffolds		
	6% chitosan	2% CM-chitin	3% CM-chitosan
X1	6.31	7.86	5.37
X2	6.83	9.03	5.13
X3	4.74	7.34	3.19
X4	3.26	5.73	3.76
X5	5.86	5.31	2.52
X6	5.08	6.24	2.52
X7	4.29	6.90	3.66
X8	4.72	9.22	3.72
Average	5.14	7.21	3.73
Standard Deviation	1.15	1.44	1.06

CURRICULUM VITAE

Name: Ms. Laddawan Lakanaporn

Date of Birth: January 24, 1981

Nationality: Thai

University Education:

1998-2002 Bachelor Degree of Science in Chemistry, Faculty of Science and Technology, Thammasat University, Pathumthani Province, Thailand.