

REFERENCES

- Attchara Chaikaew. Anti-inflammatory activity of mangostin and mixture of mangostin and gamma-mangostin. Master's Thesis, Department of Pharmacology, Faculty of Medicine, Chiangmai University, 1988.
- Balasubramanian, K., and Rajagopalan, K. Phytochemistry 27 (1988): 1552.
- Brinkhaus, B., Lindner, M., Schuppan, D., et al. Chemical, pharmacological and clinical profile of the East Asian medical plant *Centella asiatica*. Phytomedicine 7(5) (2000): 427-448.
- Brinckmann, J. A. and Lindenmaier, M. P. Herbal drugs and phytopharmaceuticals: a handbook for practice on a scientific basis 3rd ed. Germany: Medpharm scientific publishers, 2004.
- Buntrock, P., Jentsch, K. D. and Heder, G. Stimulation of wound healing using brain extract with fibroblast growth factor (FGF) activity II, Histological and morphometric examination of cells and capillaries. Experimental Pathology 21(1) (1982): 62-67.
- Cesarone, M. R., Laurora, G., De Sanctis, M. T. Activity of *Centella Asiatica* in venous insufficiency. Minerva cardioangiol 40(4) (1992): 137-143.
- Cesarone, M. R., Belcaro, G., Rulo, L. Microcirculatory effects of total triterpenic fraction of *Centella Asiatica* in chronic venous hypertension. Angiology 52 (10 suppl 2) (2001): S45-S48.
- Cheng, C. L., and Koo, M. W. L. Effects of *Centella Asiatica* on ethanol induced gastric mucosal lesions in rats. Life sciences 67(21) (2000): 2647-2653.
- Cheng, C. L., Guo, J. S., Luk, J. and Koo, M. W. L. The healing effects of *Centella* extract and asiaticoside on acetic acid induced gastric ulcers in rats. Life sciences 74 (2004): 2237-2249.

- Chomnawang, M. J., Surassmo, S., Nukoolkarn, V. S. and Gritsanapan, W. Antimicrobial effects of Thai medicinal plants against acne-inducing bacteria. Journal of Ethnopharmacology.101 (2005): 330-333.
- Davis, S. S. and Khanderia, M. S. Rheological characterisation of plastibases and the effect of formulation variables on the consistency of these vehicles, I. Continuous shear viscometry. Int. J. Pharm. Tech&Prod.Mfr. 2 (1980): 11-17.
- Davis, S. S. and Khanderia, M. S. Rheological characterisation of plastibases and the effect of formulation variables on the consistency of these vehicles, Formulation variables. Int. J. Pharm. Tech&Prod.Mfr. 2 (1981): 33-39.
- De Sanctis, M. T., Belcaro, G. and Incandela, L. Treatment of edema and increased capillary filtration in venous hypertension with total triterpenic fraction of *Centella Asiatica*: A clinical, prospective, placebo-controlled, randomized, dose-ranging trial. Angiology 52 (10 suppl 2) (2001): S55-S59.
- Foster, S., Wurster, D.E., Higuchi, T. and Busse, L. W. A pharmaceutical study of jelene ointment base. J. American Pharmaceutical Association (1951): 123-125.
- Glasstone, S., Laidler, K.J. and Eyring, H. Theory of rate processes. New York: McGraw-Hill, 1941.
- Inamdar, P. K., Yeole, R. D., Ghogare, A. B. and de Souza, N. J. Determination of biologically active constituents in *Centella Asiatica*. J.Chromatogr. A 742 (1996):127-130.
- Iinuma, M., Tosa, H., Tanaka, T., Asai, F., Kobayashi, Y., Shimano, R. and Miyauchi, K. Antibacterial activity of xanthenes from Guttiferaeous plants against methicillin-resistant *Staphylococcus aureus*. J. Pharm Pharmacol.48 (1996): 861-865.
- Kasper, D. L., Fauci, A. S., Longo, D. L., Braunwald, E., Hauser, S. L. and Jameson, J. L. Harrison's principles of internal medicine vol.II 16th ed. USA: McGraw – hill, 2005.

- Kim, C. K., Kim, J. H., Park, K. M., Oh, K. H., Oh, U. and Hwang, S. J. Preparation and evaluation of a titrated extract of *Centella Asiatica* injection in the form of an extemporaneous micellar solution. Int. J. Pharm. 146 (1997): 63-70.
- Kim, C. K., Hwang, Y. Y., Chang, J. Y., Choi, H. G., Lim, S. J. and Lee, M. K. Development of a novel dosage form for intramuscular injection of titrated extract of *Centella Asiatica* in a mixed micellar system. Int. J. Pharm. 220 (2001): 141-147.
- Kiesswetter, H. Treatment of wounds with asiaticoside (Madecassol). Wien. Med. Wochenschr. 114 (1964): 124-126.
- Krutchkoff, D. J., Culter, L. and Laskowski, S. Oral lichen planus: the evidence regarding malignant transformation. J. Oral. Pathol. 7 (1978): 1-7.
- Lawrence, M., Tierney, Jr. Stephen, J. M. and Maxine, A.P. The current medical diagnosis & treatment 39th ed. McGraw-Hill, 2000.
- Llum, L. Chitosan and its use as a pharmaceutical excipient. Pharm. Res. 15 (9) (1998): 1326-1331.
- Lodi, G., Scully, C., Carrozzo, M., Griffiths, M., Sugerman, P. B. and Thomgrasom, K. Current controversies in oral lichen planus: report of an international consensus meeting. Part 1. viral infections and etiopathogenesis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 100 (2005): 40-51.
- Loitz, G. A. and O'leary, J. P. Erosive lichen planus of the tongue treated by cryosurgery. J Oral Maxillofac Sur. 44 (1986): 580-582.
- Lozada -Nor, F. and Miranda, C. Oral lichen planus : topical and systemic therapy. Semin Cutan Med Surg 16 (1997): 295-300.
- Mahabusarakum, W., Wiriyachitra, P. and Phongpaichit, S. Antimicrobial activities of chemical constituents of *Garcinia mangostana* Linn. J.Sci. Soc. Thailand. 12 (1986): 239-242.
- Mahabusarakum, W., Wiriyachitra, P. and Taylor, W. C. Chemical constituents of *Garcinia mangostana*. J. Natural products. 50 (1987): 474-478.

- Maquart, F. X., Bellon, G., Gillery, P., Wegrowski, Y. and Borel, J. P. Stimulation of collagen synthesis in fibroblast cultures by a triterpene extracted from *Centella Asiatica*. Connective Tissue Research 24 (1990): 107-120.
- Martin, A. N., Swarbrick, J. and Cammerata, A. Physical pharmacy Chap.18. Philadelphia: Lea and Febiger, 1968.
- Mutimer, M. N., Riffkin, C., John, A.H. and Gilman, N. Modern ointment base technology I, Properties of hydrocarbon gels. J. American Pharmaceutical Association (1956): 101-105.
- Okamoto, Y., Shibuzaki, K. Matsubishi, A. Tanioka, S. and Shigemesa, Y. Evaluation of chitin and chitosan on open wound healing in dogs. J Vet. Med. Sci. 57 (1995): 851-854.
- Orenti, I., Cerchiara, T., Luppi, B., Bigucci, F., Zuccari, G. and Zecchi, V. Influence of difference chitosan salts on the release of sodium diclofenac in colon-specific delivery. Int. J Pharm. 238 (2002):51-59.
- Paveen, M. and Ud- Din Khan, N. Phytochemistry 27 (1988): 3694.
- Phongpaichit, S., Ongsakul, M., Nilrat, L., Tharavichitkul, P., Bunchoo, S., Chuaprapaisilp, T. and Wiriyachitra, P. Antibacterial activities of extracts from *Garcinia mangostana* pericaps on methicillin-resistant *Staphylococcus aureus* and *Enterococcus* species. Songklanakarin J. Sci. Technol. 16 (1994): 399-405.
- Sandford, P. A. High purity chitosan and alginate. Frontiers of Carbohydrate Research 2 (Chandrasekaran.R. ed.). New York: Elsevier, 1992. pp. 250-269.
- Sasaki, S., Shinkai, H. , Akashi, Y. and Kishihara, Y. Studies on the mechanism of action of asiaticoside (Madecassol[®]) on experiment granulation tissue and cultured fibroblasts and its clinical application in systemic sclerodema. Acta Dermatovenerolog. (Stockholm) 52 (1972): 141-150.
- Scully, C. and Elkom, M. Lichen planus: review and update on pathogenesis. J Oral. Pathol. 14 (1985): 431-458.

- Shanmugasundaram, N., Ravichandran, P., Neelakanta, R.P., Nalini, R., Subrata, P. and Panduranga, R.K. Collagen-chitosan polymeric scaffolds for the in vitro culture of human epidermoid carcinoma cells. Biomaterials 22 (2001):1943-1951.
- Shankaranarayan, D., Gopalakrishnan, C. and Kameswaran, L. Arch.Int. Pharmacodyn. 239 (1979): 257.
- Shukla, A., Rasik, A. M., Jain, G. K., Shankar, R., Kulshrestha, D. K. and Dhawan, B. N. In vitro and in vivo wound healing activity of asiaticoside isolated from *Centella Asiatica*. J. Ethnopharmacology 65 (1999): 1-11.
- Sornprasit, A., Sripiriyarattankul, K., Chuay-Yim, P. and Tanakittithum, P. Preliminary toxicological study of mangostin. Songklanakarinn J. Sci. Technol. 9 (1987): 51-57.
- Tallat, H. A. and Abbas, M. E. The effect of titrated extract of *Centella Asiatica* on abnormal scar formation. J. Egypt. Surg. Soc. 6 (1971): 408-419.
- Thau, P. and Fox, C. A new procedure for the preparation of polyethylene-mineral oil gels. J. Soc. Cosmetic Chemists 16 (1965): 359-363.
- Towle, G. A. and Christensen, O. Pectin. Industrial gums (R.L. Whistler, ed.). New York: Academic Press, 1973. pp. 429-461.
- Thongprasom, K., Luengvisut, P., Wongwatanakij, A. and Boonjatturus, C. Clinical evaluation in treatment of oral lichen planus with topical fluocinolone acetonide: a 2-year follow up. J Oral. Pathol. Med. 32 (2002): 315-322.
- Ueno, H. Yamada, H. Tanaka, I. Kaba, N. Matsuura, M. Okumura, M. Kadosawa, T. and Fujinaga, T. Accelerating effects of chitosan for healing at early phase of experimental open wound in dogs. Biomaterials. 20 (1999): 1407-1414.
- Ulbricht, C. E. and Basch, E. M. Natural standard herb & supplement reference. Evidence-base clinical reviews. USA: Elsevier mosby, Inc, 2005.
- United States Pharmacopeia (USP23), The United States Pharmacopeial Convention, Inc. Rockville: 1994.

- Veechai, A. D., Senmi, J., Gassan, G. and Mohinaro, M. Effect of *Centella Asiatica* on the biosynthetic activity of fibroblast in culture. Farmacie Edition 39 (1984): 355-364.
- Walsh, L. J., Savage, N. W., Ishii, T. and Seymour, G. J. Immunopathogenesis of oral lichen planus. J. Oral Patho Med . 9 (1990): 389-396.
- Weiss, R. F. and Fintelmann, V. Herbal medicine 2nd ed. Italy: Grafiche fover, Foligno, 2000.
- Wilawan mahabusarakam, Pichaet wiriyachitra, Thavatchai chuaprapaislip, Souwalak Pongpaichit, Chaweewan jansakul, Metta ongsakul and Amporn sornprasit. MANGOSTIN: A new treatment for ecthyma. Present at 7TH regional conference on dermatology. Australian- asian. Bangkok. (1986).
- Yoshida, A., Manosroi, A., Manosroi, J., Yamauchi, H. and Abe, M. Molecular interactions between phospholipids and mangostin in a lipid bilayer. Colloids and surfaces B.4 (1995): 423-432.
- Zatz, J. I. and Knapp, S. J. Pharm. Sci. 73 (1984): 468.

APPENDIX

Table 25 Calibration data of mangostin in methanol solution at 244 nm

Concentration ($\mu\text{g/ml}$)	Area
5	346382
10	701591
20	1386315
30	2068192
40	2835249
60	4094030

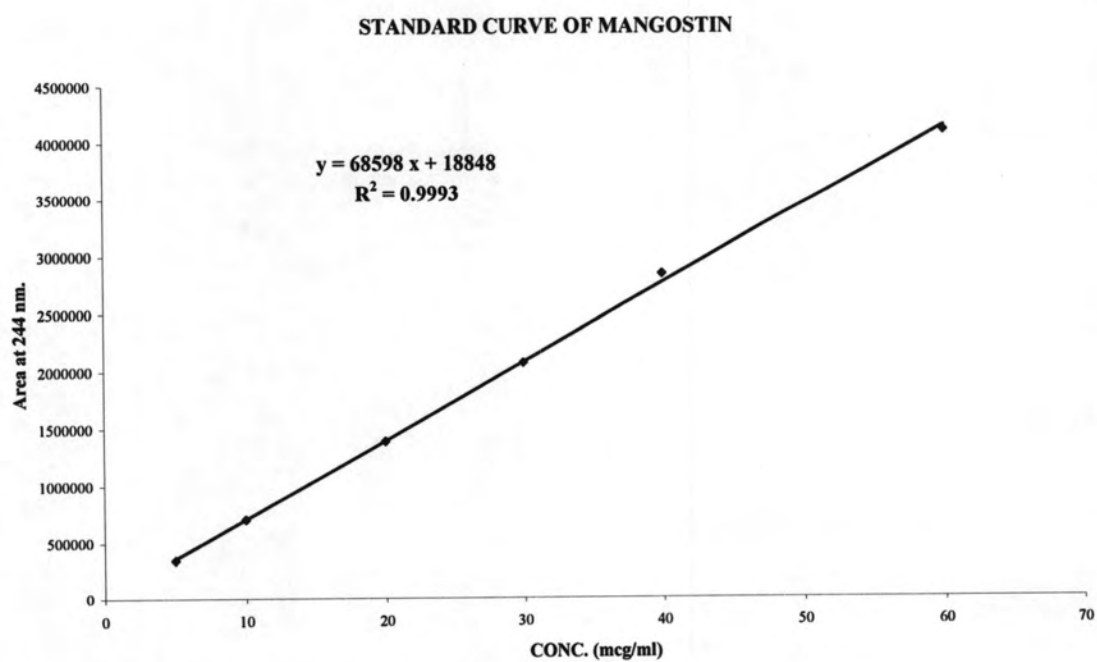
**Figure 73** Standard calibration curve of mangostin in methanol at 244 nm

Table 26 Data of precision of mangostin

Number	Area at 244 nm.		
	1 st day	2 nd day	3 rd day
1	1249727	1226687	1302918
2	1258138	1229255	1301266
3	1250646	1234290	1298511
4	1257505	1227321	1296223
5	1252321	1231682	1302134
6	1249417	1230720	1301320
Average	1252959	1229993	1300395
SD	3904.79	2844.62	2528.20
%CV	0.312	0.231	0.194

Table 27 The percentage of recovery of mangostin

Analytical concentration ($\mu\text{g/ml}$)	% Recovery of Mangostin				
	1	2	3	Average	SD
5	100.29	101.74	101.35	101.13	0.75
10	99.79	101.50	101.53	100.94	0.996
20	101.19	102.17	103.03	102.13	0.923
30	103.92	105.20	105.31	104.81	0.773
40	103.53	105.61	105.67	104.94	1.219

Table 28 Calibration data of asiaticoside in methanol solution at 210 nm

Concentration ($\mu\text{g/ml}$)	Area
50	177186.70
100	358463.30
200	699775.30
300	1045602
400	1446004
600	2123730

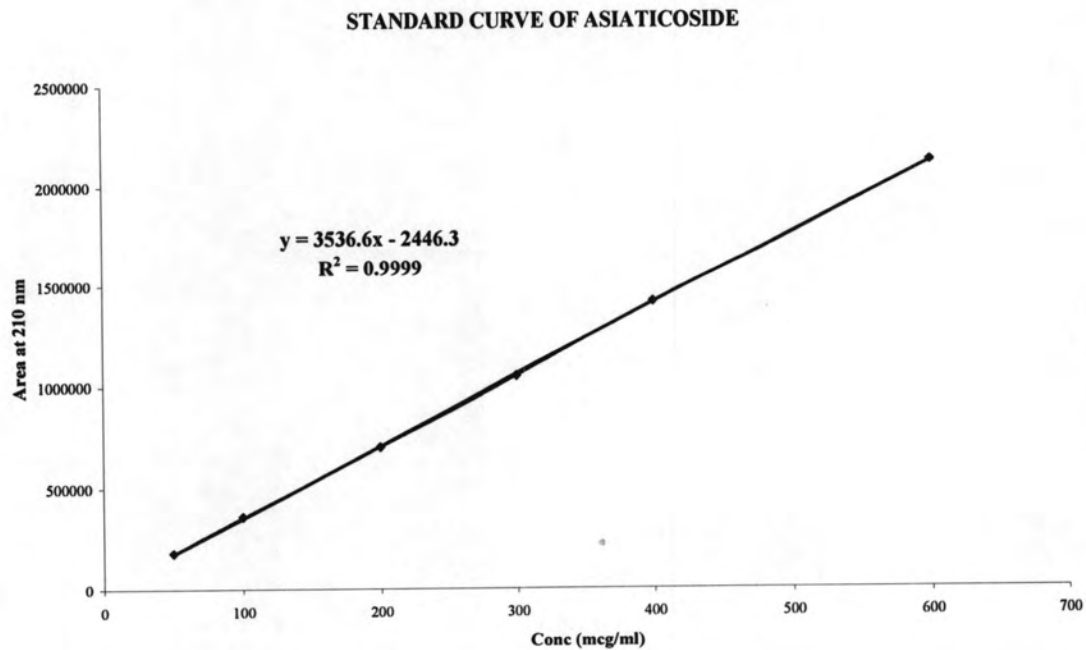
**Figure 74** Standard calibration curve of asiaticoside in methanol at 210 nm

Table 29 Data of precision of asiaticoside

Number	Area at 210 nm.		
	1 st day	2 nd day	3 rd day
1	655031	646009	655725
2	658847	647880	659730
3	661412	646334	650957
4	660576	647803	649988
5	665990	644871	648439
6	662858	643921	638960
Average	660785.67	646136.33	650633.17
SD	3706.49	1573.67	7074.99
%CV	0.561	0.244	1.087

Table 30 The percentage of recovery of asiaticoside

Analytical concentration (µg/ml)	% Recovery of Asiaticoside				
	1	2	3	Average	SD
50	101.91	102.71	99.37	101.33	1.74
100	102.14	102.44	101.78	102.12	0.33
200	103.86	102.79	103.96	103.54	0.65
300	102.20	103.24	103.04	102.83	0.55
400	100.32	101.25	101.71	101.09	0.71

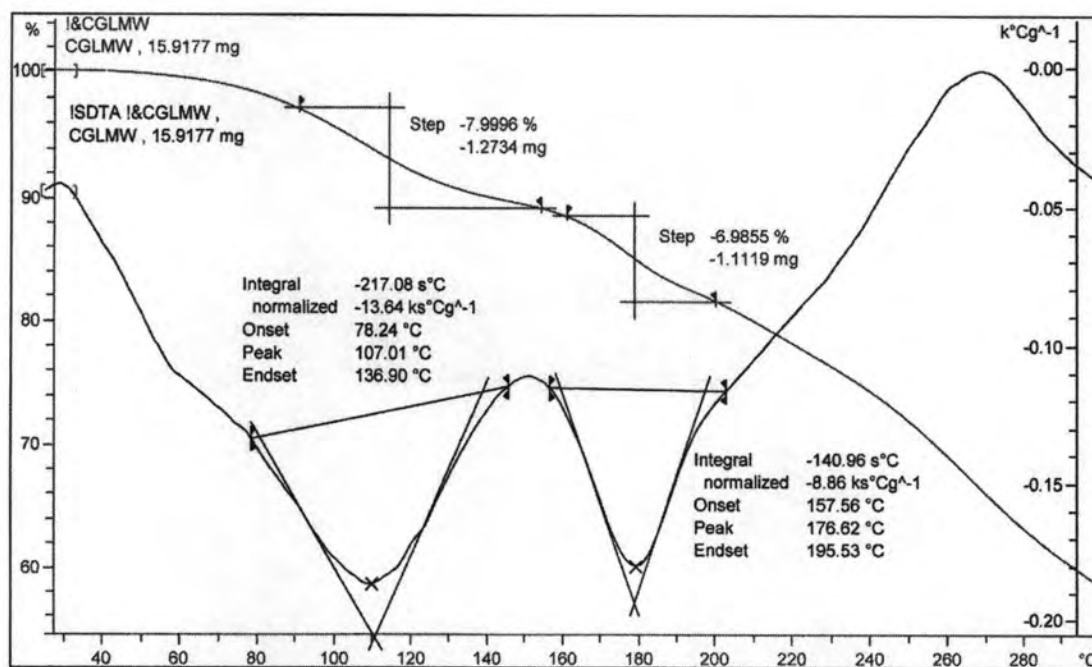


Figure 75 TGA scan of chitosan glutamate MW 83000

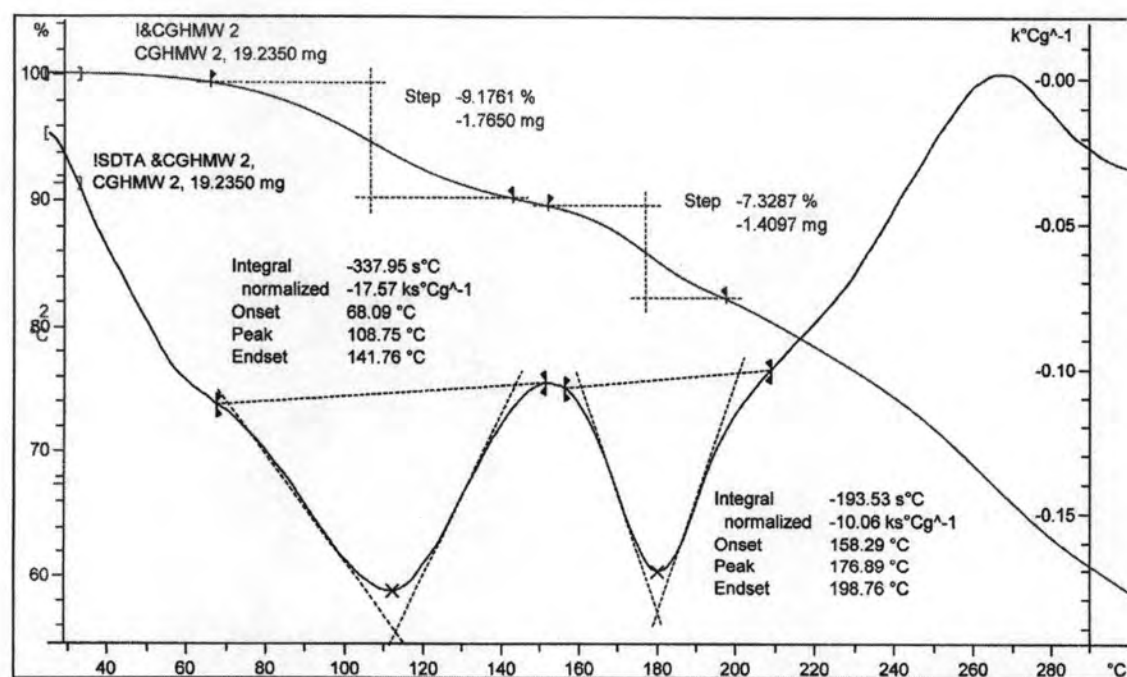


Figure 76 TGA scan of chitosan glutamate MW 227000

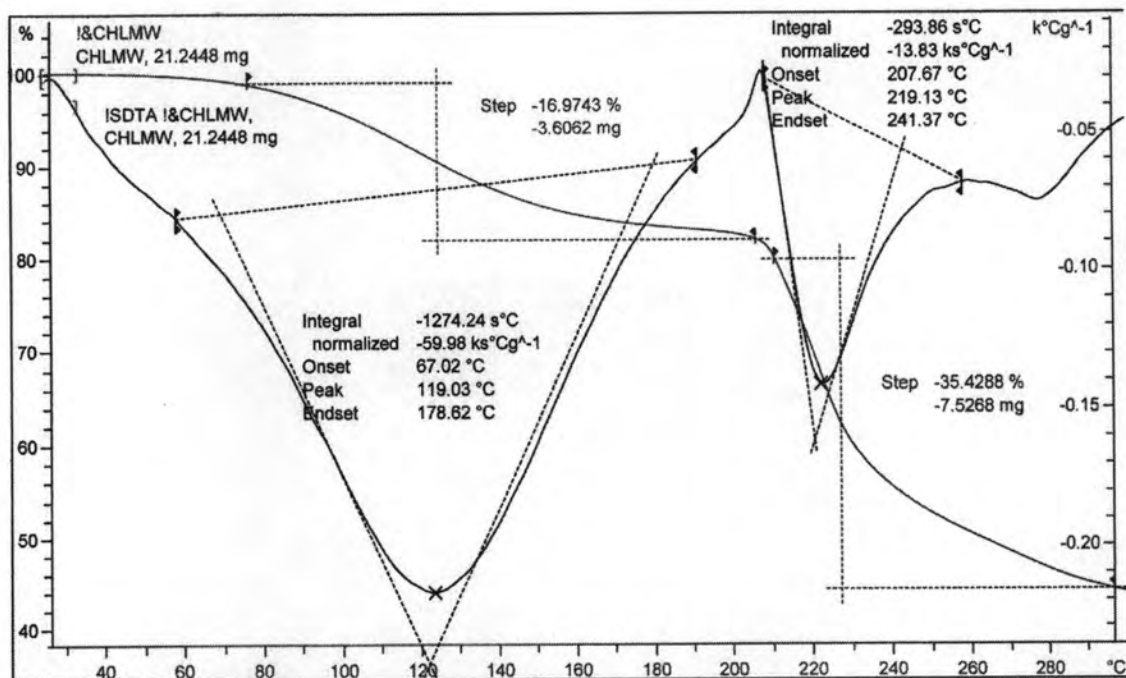


Figure 77 TGA scan of chitosan hydrochloride MW 83000

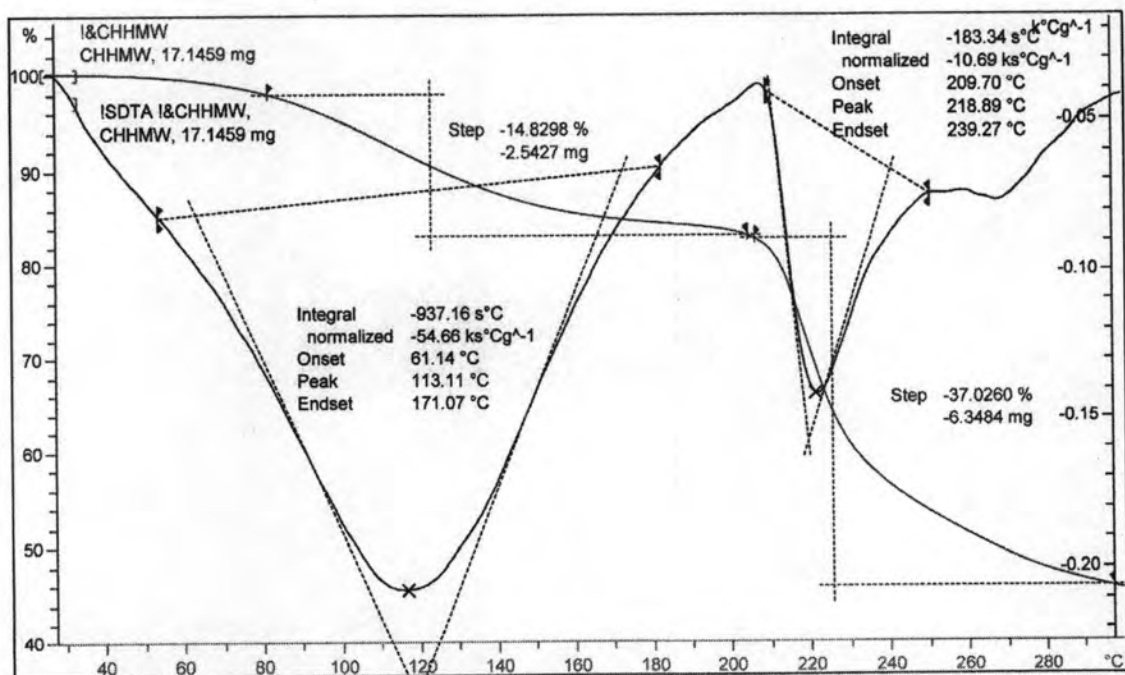


Figure 78 TGA scan of chitosan hydrochloride MW 227000

VITA

Chanchit Leesatjakul was born in Bangkok, Thailand, on July 18th, 1978. He received the Bachelor of Science degree in Pharmacy in 2002 from Faculty of Pharmaceutical Sciences, Chulalongkorn University, Thailand. He also worked at Siam Bheasach Co, Ltd., in position of production supervisor during the year of 2002 to 2004.