

## REFERENCES

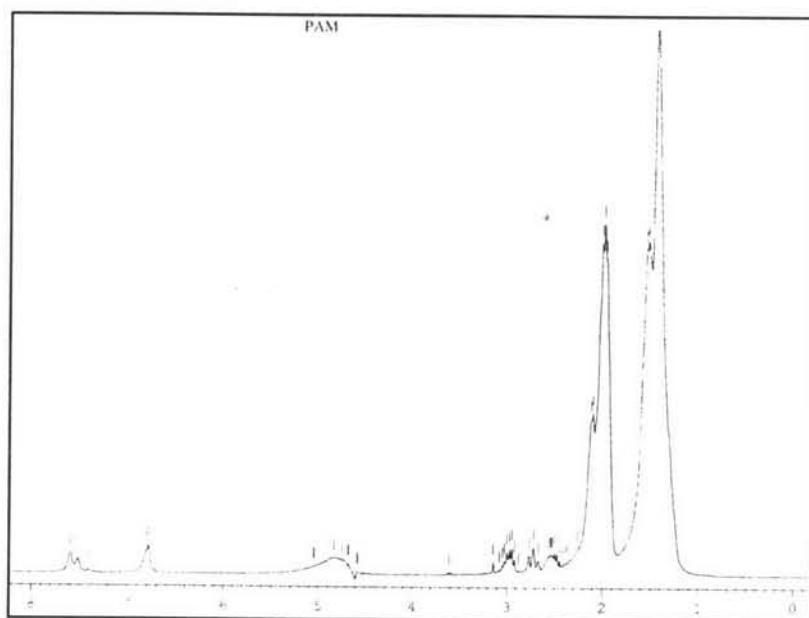
- Ahn, J-S., Choi, H-K., Lee, K-H., Nahm, J-H., and Cho, C-S. (2001) Novel mucoadhesive polymer prepared by template polymerization of acrylic acid in the presence of silk sericin. Journal of Applied Polymer Science, 80, 274-80.
- Becker, M.A., Willman, P., and Tuross, N.C. (1995) The U.S. first ladies gowns: A Biochemical study of silk preservation. Journal of the American Institute for Conservation, 34(2), 141-152.
- Biswal, D.R., Singh, R.P. (2004) Charaterisation of carboxymethyl cellulose and polyacrylamide graft polymer. Carbohydrate Polymers, 57, 379-387.
- Cho,K-Y., Moon, J-Y., Lee, Y-W., Lee, K-G., Yeo, J-H., Kweon, H-Y., Kim, K-H., and Cho, C-S. (2003) Preparation of self-assembled silk sericin nanoparticles. International Journal of Biological Macromolecules, 32, 36-42.
- Demir, M.M., Yilgor, I., and Erman, B. (2002) Electrospinning of polyurethane fibers. Polymer, 43, 3303-3309.
- Freddi, G., Tsukada, M., and Beretta, S. (1999) Structure and physical properties of silk fibroin/polyacrylamide blend films. Journal of Applied Polymer Science, 71, 1563-1571.
- Gaskell, S.J. (1997) Electrospray : Principles and Practice. Journal of Mass Spectrometry, 32, 677-688.
- Gotoh, Y., Tsukada, M., and Minoura, N. (1993) Chemical modification of silk fibroin with cyanuric chloride-activated poly(ethylene glycol): Analyses of reaction site by <sup>1</sup>H-NMR spectroscopy and conformation of the conjugates. Bioconjugate Chemistry, 4, 554-559.
- Gotoh, Y., Niimi, S., Hayakawa, T., Miyashita, T. (2004) Preparation of lactose-silk fibroin conjugates and their application as a scaffold for hepatocyte attachment. Biomaterials, 25, 1131-1140.
- Hoppe, U. and Engel, W. (1989) Cosmetic agents for hair. U.S.Patent 4,839,165.

- Huang, Z-M., Zhang Y.Z., Ramakrishna, S., and Lim, C.T. (2004) Electrospinning and mechanical characterization of gelatin nanofibers. *Polymer*, 45, 5361-5368.
- Ishikawa, H., Nagura, M., and Tsuchiya, Y. (1987) Fine structure and physical properties of blend film composed of silk sericin and poly(vinyl alcohol). *Sen'i Gakkaishi*, 43(6), 283-7.
- Jeong, Y., Nah, J-W., Na, H-K., Na, K., Kim I-S., Cho, C-S., and Kim S-H. (1999) Self-assembling nanospheres of hydrophobized pullulans in water. *Drug Development and Industrial Pharmacy*, 25(8), 917-927.
- Kim, B., Park, H., Lee, S-H., and Sigmund, W.M. (2005) Poly(acrylic acid) nanofibers by electrospinning. *Materials letters*, 59, 829-832.
- Lee, K.G., Kweon, H.Y., Yeo, J.H., Woo, S.O., Lee, Y.W., Cho, C-S., Kim, K.H., and Park, Y.H. (2003) Effect of methyl alcohol on the morphology and conformation characteristics of silk sericin. *International Journal of Biological Macromolecules*, 33, 75-80.
- Mizoguchi, K., Iwatubo, T., and Aisaka, N. (1991) Separating membrane made of cross-linked thin film of sericin and production. *Japan Patent* 03-284337A.
- Murase, M. (1994) Method for solubilizing and molding cocoon silk, artificial organ made of cocoon silk, and medical element made of cocoon silk. *Japan Patent* 06-166850A.
- Nabeshima, K., Oyabu, I., Nakano, T., Yamada, H., Nokata, A., and Nomura, M., (1997) Functional fiber product. *Japan Patent* 09-158048A.
- Ohgo, K., Zhao, C., Kobayashi, M., and Asakura, T. (2003) Preparation of non-woven nanofibers of *Bombyx mori* silk, *Samia Cynthia ricini* silk and recombinant hybrid silk with electrospinning method. *Polymer*, 44, 841-846.
- Park, W.H., Jeong, L., Yoo, D.I., and Hudson, S. (2004) Effect of chitosan on morphology and conformation of electrospun silk fibroin nanofibers. *Polymer*, 45, 7151-7157.
- Pelyonen, L., Aitta, J., Hyvönen, S., Karjalainen, M., and Hirvonen, J. (2004) Improved entrapment efficiency of hydrophilic drug substance during nanoprecipitation of poly(l)actide nanoparticles. *American Association of Pharmaceutical Scientists PharmSciTech*, 5(1), 1-6.

- Sarovart, S., Sudatis, B., Meesilpa, P., Grady, P.B., and Magaraphan, R. (2003) The use of sericin as an antioxidant and antimicrobial for polluted air treatment. Reviews on Advanced Material Science, 5, 193-198.
- Simon J. G. (1997) Electrospray : Principles and Practice. Journal of mass spectrometry, 32, 677-688.
- Teramoto, H., Nakajima, K., and Takabayashi, C. (2004) Chemical modification of silk sericin in lithium chloride/dimethyl sulfoxide solvent with 4-cyanophenyl isocyanate. Biomacromolecules, 5, 1392-1398.
- Tsukada, M., Goto, Y., Freddi, G., and Shiozaki, H. (1992) Chemical modification of silk with aromatic acid anhydrides. Journal of Applied Polymer Science, 45, 1189-1194.
- Tsukada, M., Gotoh, Y., Shiozaki, H., Freddi, G., and Crighton, J.S. (1994) Physical characteristics of silk fibers modified with dibasic acid anhydrides. Journal of Applied Polymer Science, 51, 345-352.
- Ueda, K. and Makita, M. (2000) Rubber molding having durable skincare property. Japan Patent 2000-169595A.
- Wang, Q., and He, L. (1997) Formation and characterization of P(AN-AM-AA)/PVA intermacromolecular complex through hydrogen bonding. Polymer, 38, 3931-3935.
- Wang, S., Goto, Y., Ohkoshi, Y., and Nagura, M. (1998) Structures and physical properties of poly (vinyl alcohol)/sericin blend hydrogel membranes. Journal of Sericultural Science Japan, 67(4), 295-302.
- Yamada, H. and Fuwa, Y. (1993) Pervaporation membrane and production. Japan Patent 05-345118A.
- Yamada, H. and Nomura, M. (1998) Fibrous article for contact with skin. Japan Patent 10-001872A.
- Yoshikawa, M., Murakami, A., and Okushita, Y. (2001) A blend film containing agar or/and agarose, and sericin and production thereof. Japan Patent 2001-129371A.
- Zarkoob, S., Eby, R.K., Reneker, D.H., Hudson, S.D., Ertley, D., Adams, W.W. (2004) Structure and morphology of electrospun silk nanofibers. Polymer, 45, 3973-3977.

Zhang, Y.Q. (2002) Applications of natural silk protein sericin in biomaterials.  
Biotechnology Advances, 20, 91-100.

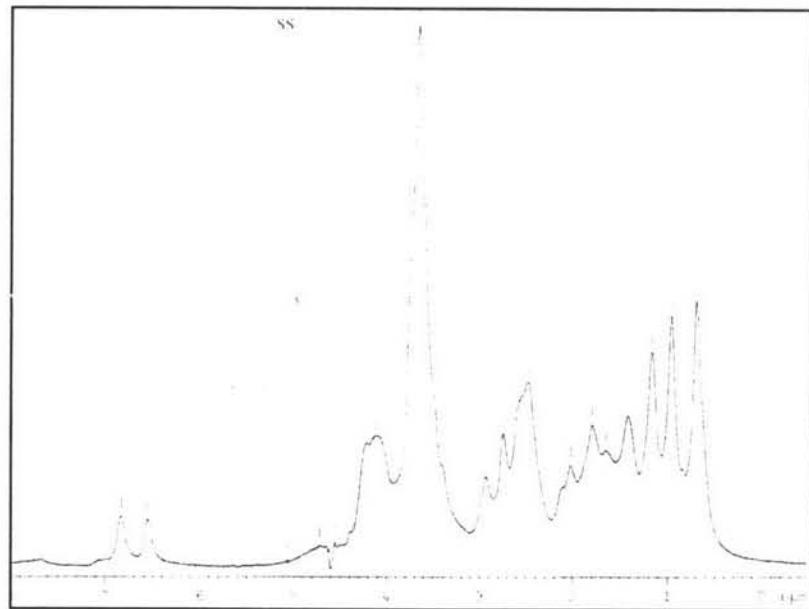
## APPENDIX



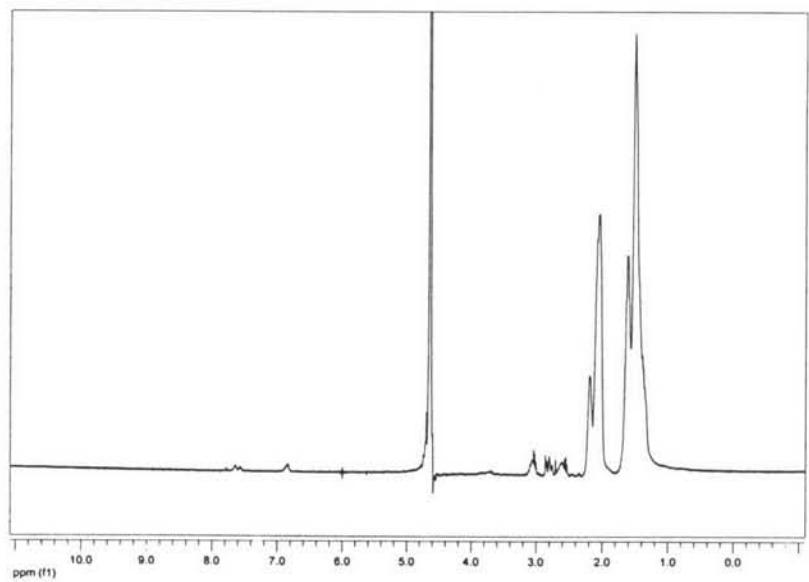
**Figure A1**  $^1\text{H}$ -NMR spectrum (in  $\text{D}_2\text{O}$ ) of PAM.

**Table A1** Chemical shifts of PAM

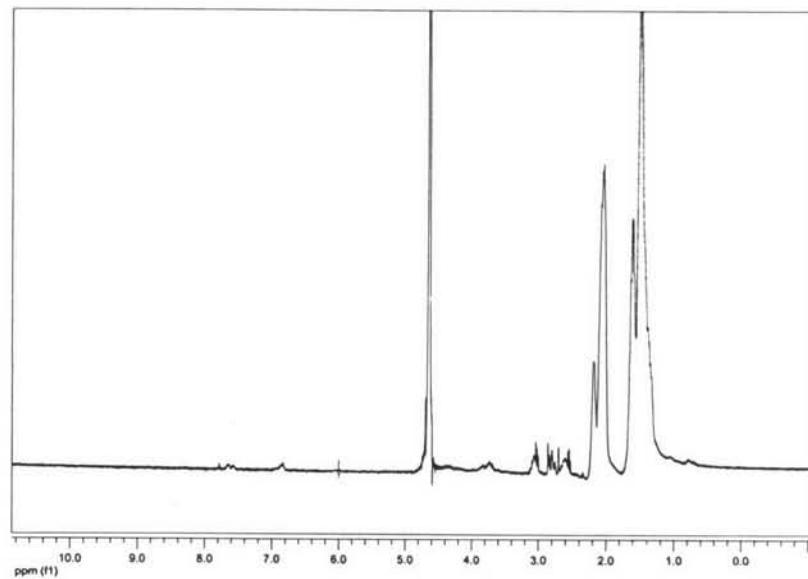
Material	Chemical shift (ppm)	Type of proton	Chemical structure
PAM	1.425	$\text{H}^\beta$	<p>The chemical structure of the repeating unit of PAM is shown. It consists of a methylene group (<math>\text{CH}_2</math>) attached to an amide group (<math>\text{C}(=\text{O})\text{NH}_2</math>). The carbon atom bonded to the amide group is labeled <math>\alpha</math>, the carbon atom bonded to the methylene group is labeled <math>\beta</math>, and the carbon atom bonded to the nitrogen is labeled <math>\gamma</math>.</p>
	1.978	$\text{H}^\alpha$	
	6.781	$\text{H}^\gamma$	



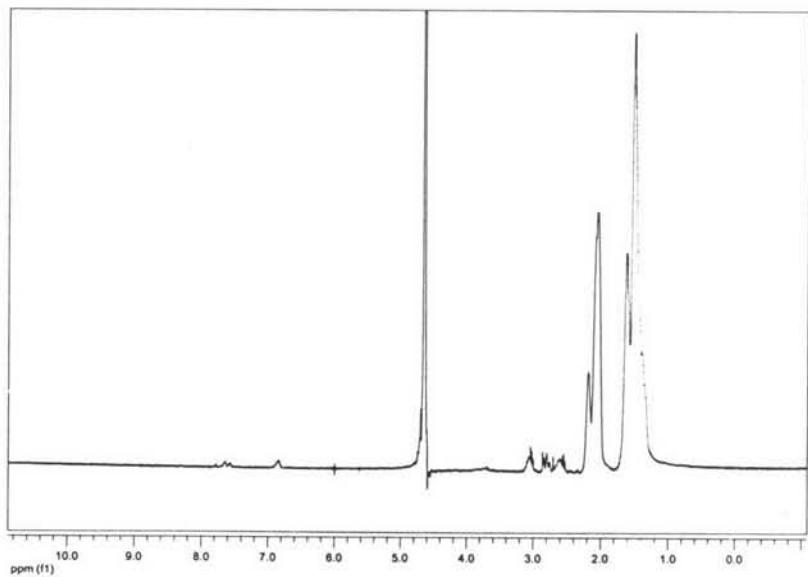
**Figure A2** <sup>1</sup>H-NMR spectrum (in  $D_2O$ ) of sericin.



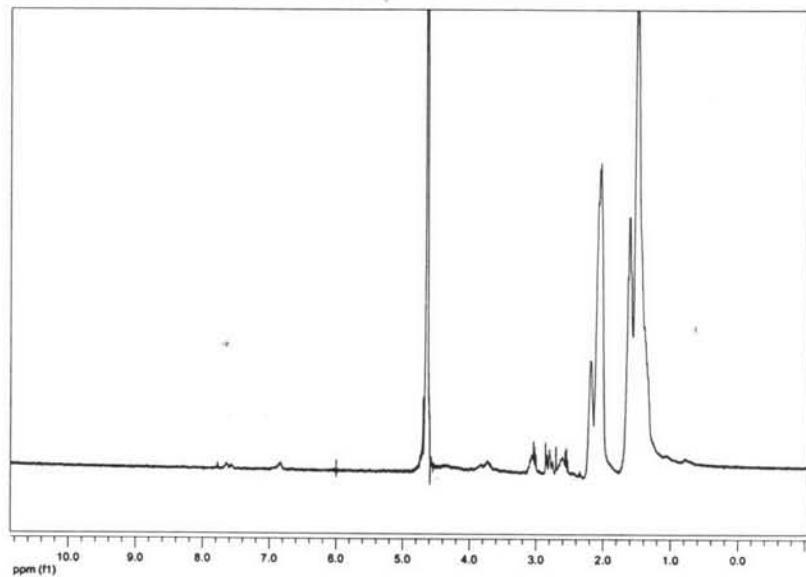
**Figure A3** <sup>1</sup>H-NMR spectrum (in  $D_2O$ ) of SS/PAM blend (10/90 w/w).



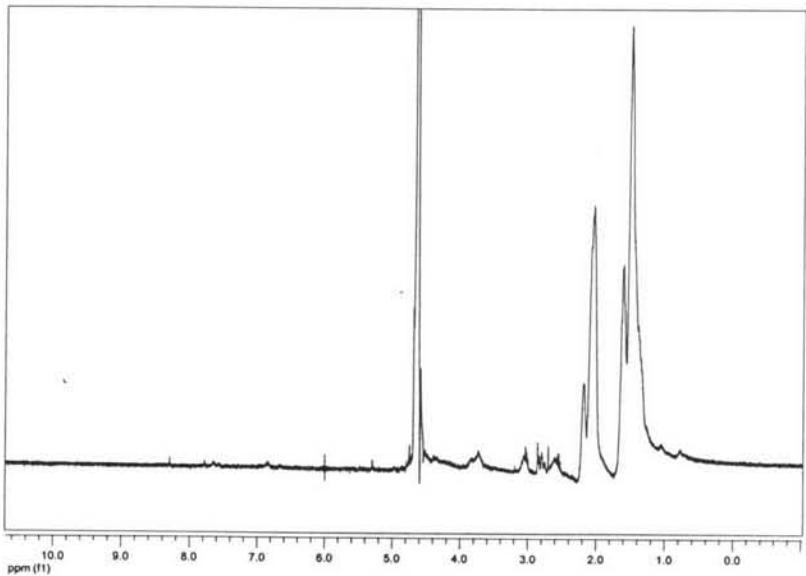
**Figure A4** <sup>1</sup>H-NMR spectrum (in  $D_2O$ ) of SS/PAM blend (20/80 w/w).



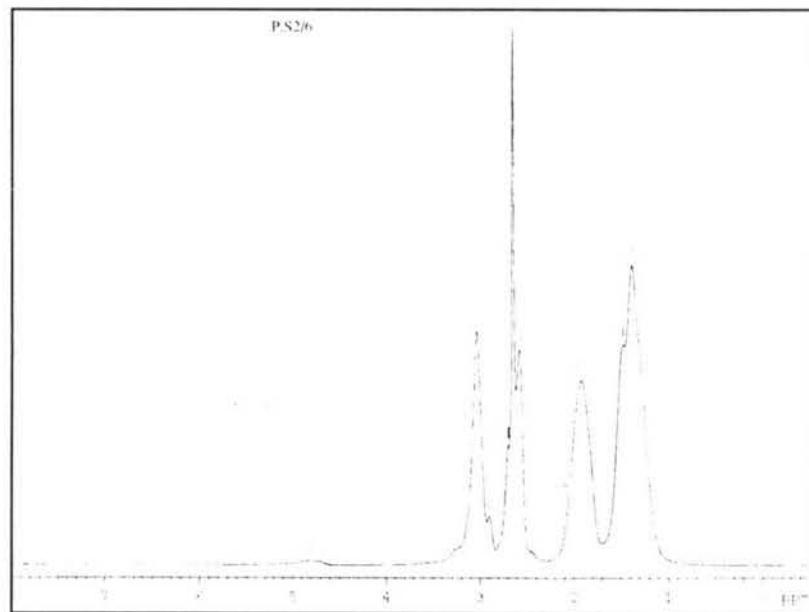
**Figure A5** <sup>1</sup>H-NMR spectrum (in  $D_2O$ ) of SS/PAM blend (30/70 w/w).



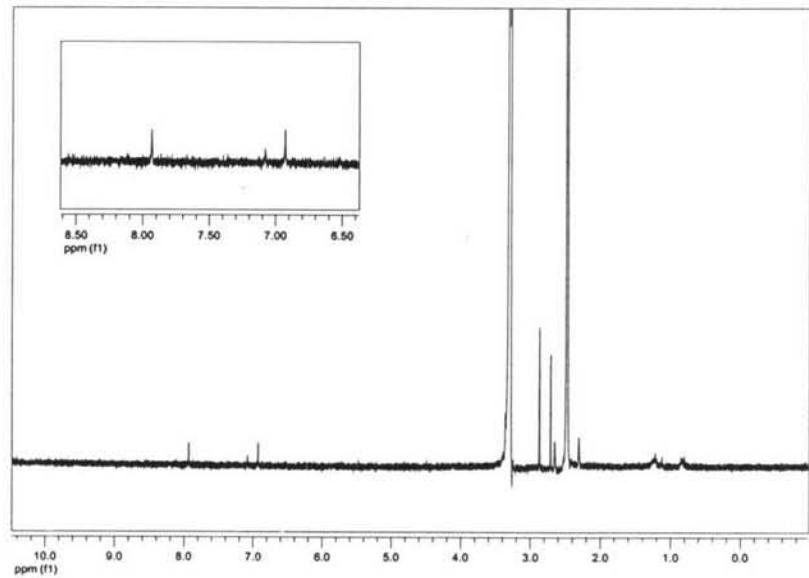
**Figure A6** <sup>1</sup>H-NMR spectrum (in  $D_2O$ ) of SS/PAM blend (40/60 w/w).



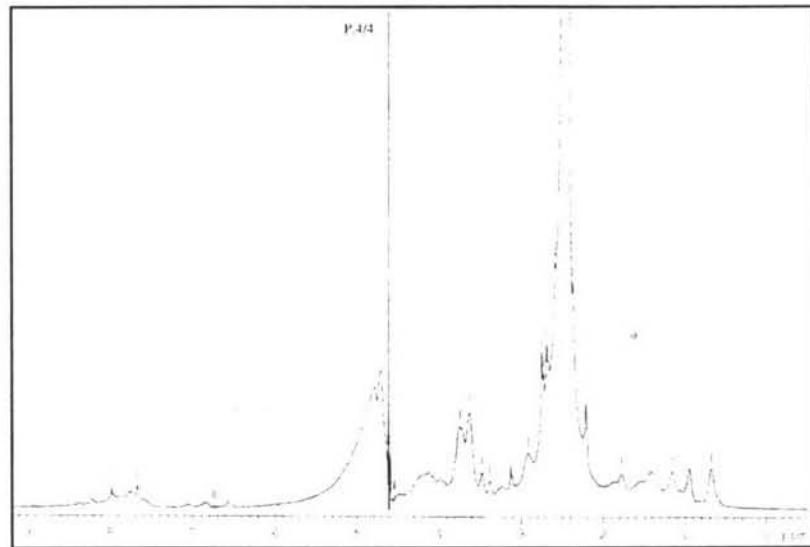
**Figure A7** <sup>1</sup>H-NMR spectrum (in  $D_2O$ ) of SS/PAM blend (50/50 w/w).



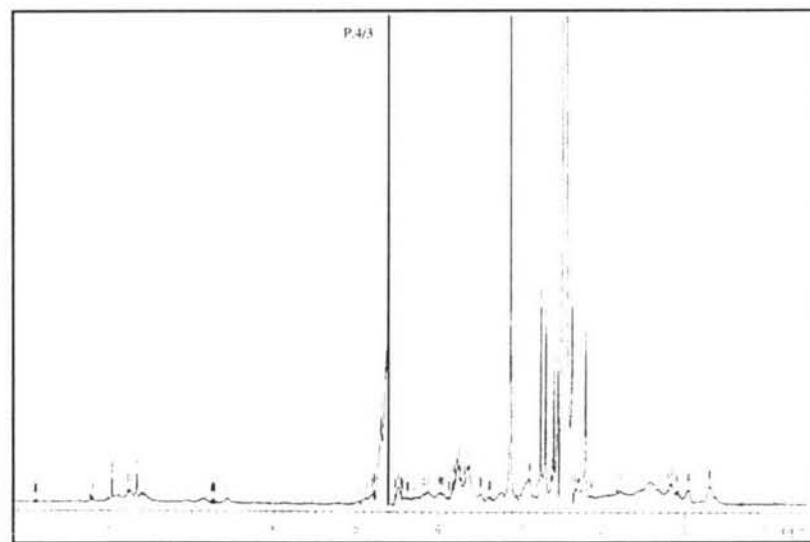
**Figure A8** <sup>1</sup>H-NMR spectrum (in D<sub>2</sub>O) of PAM derivative a.



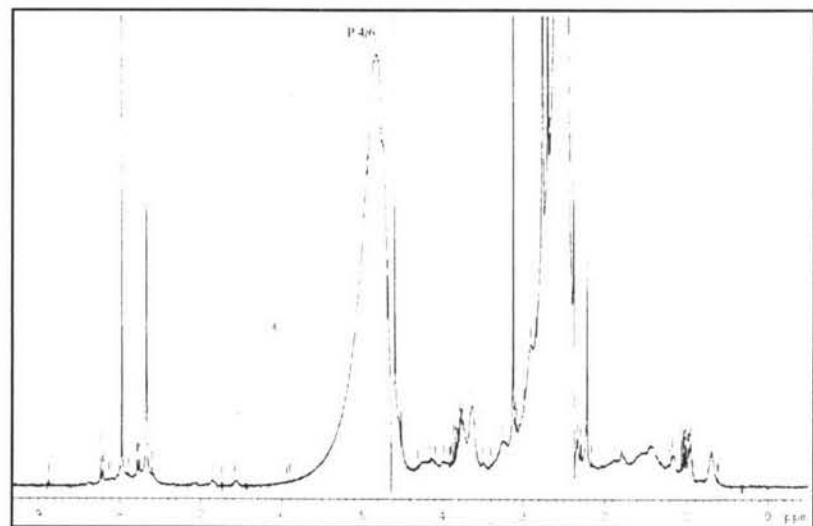
**Figure A9** <sup>1</sup>H-NMR spectrum (in D<sub>2</sub>O) of PAM derivative b.



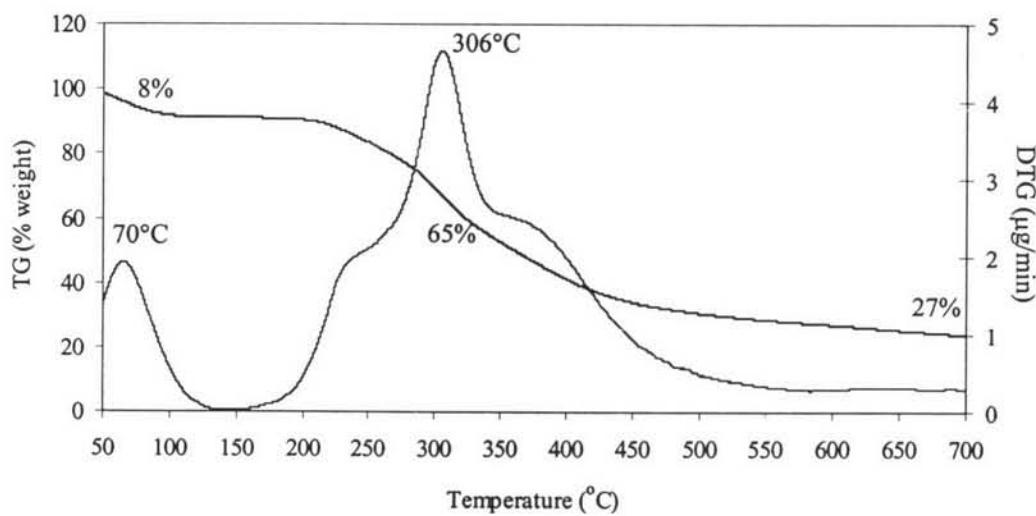
**Figure A10** <sup>1</sup>H-NMR spectrum (in  $\text{D}_2\text{O}$ ) of SS-PAM modification (1:1 w/w).



**Figure A11** <sup>1</sup>H-NMR spectrum (in  $\text{D}_2\text{O}$ ) of SS-PAM modification (1:5 w/w).



**Figure A12** <sup>1</sup>H-NMR spectrum (in D<sub>2</sub>O) of SS-PAM modification (1:10 w/w).



**Figure A13** TG/DTA curves of sericin.

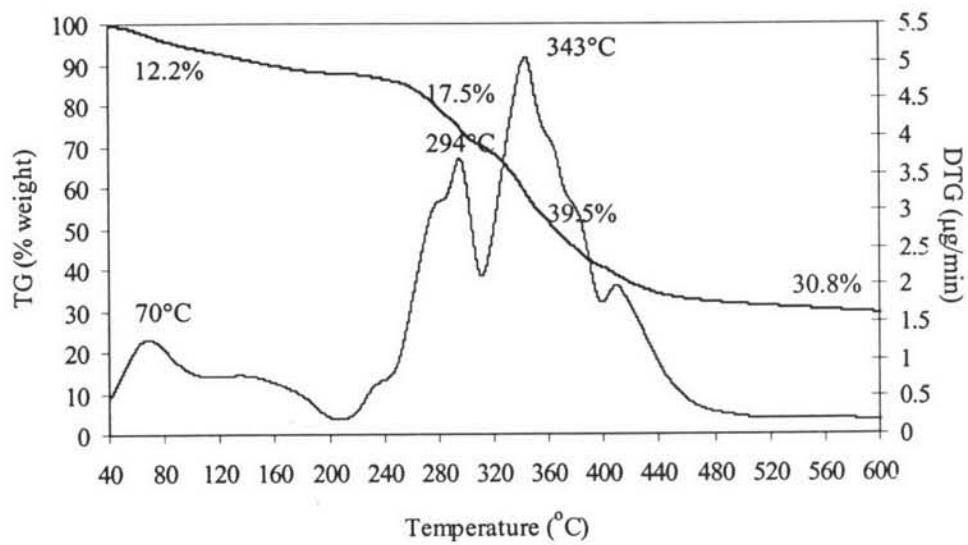


Figure A14 TG/DTA curves of PAM.

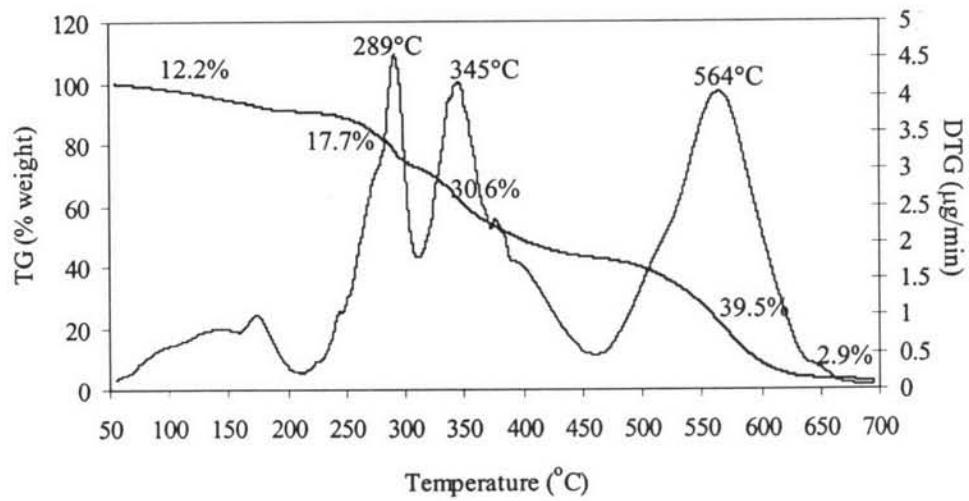
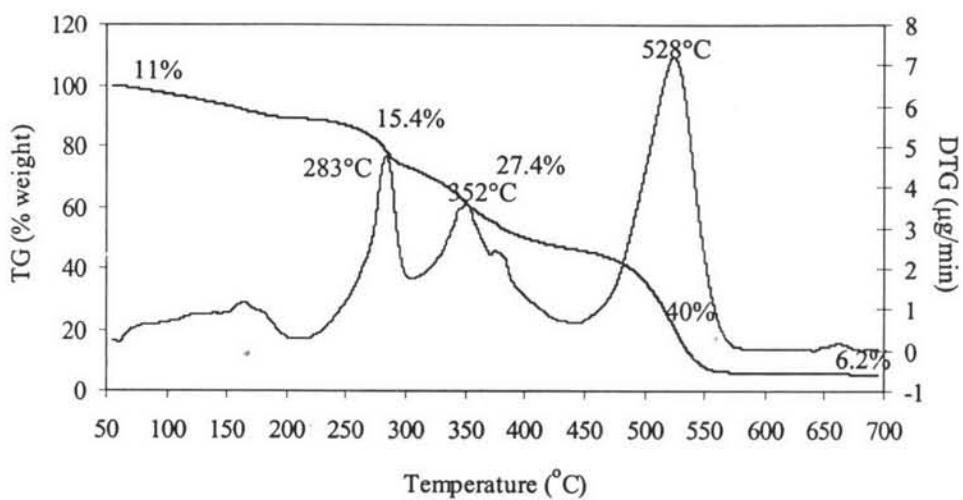
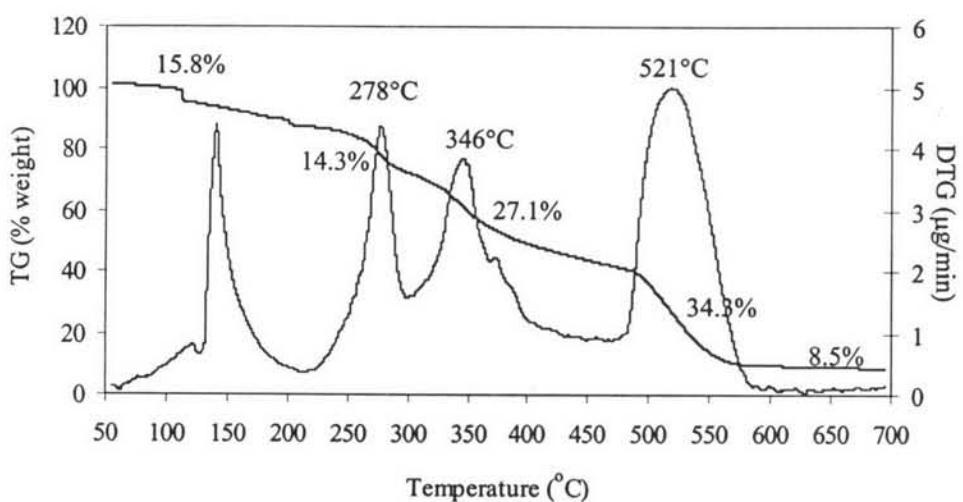


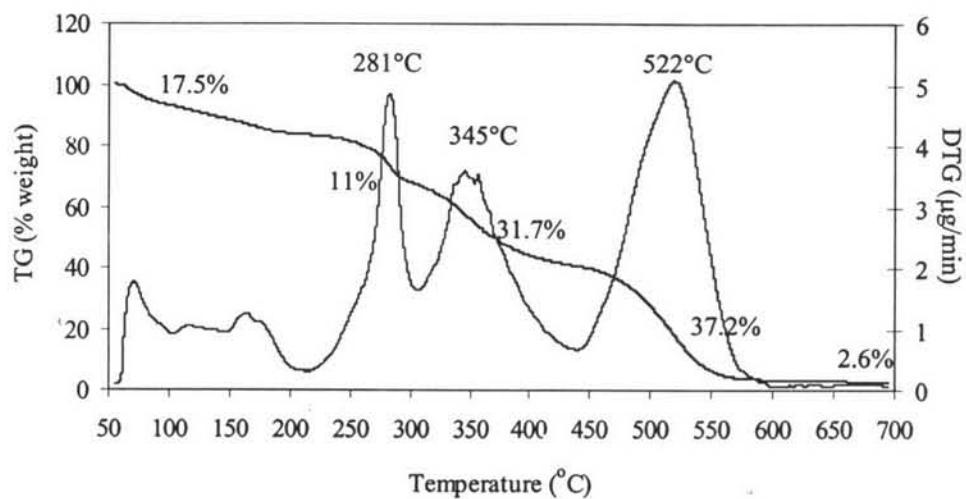
Figure A15 TG/DTA curves of SS/PAM blend (10/90 w/w).



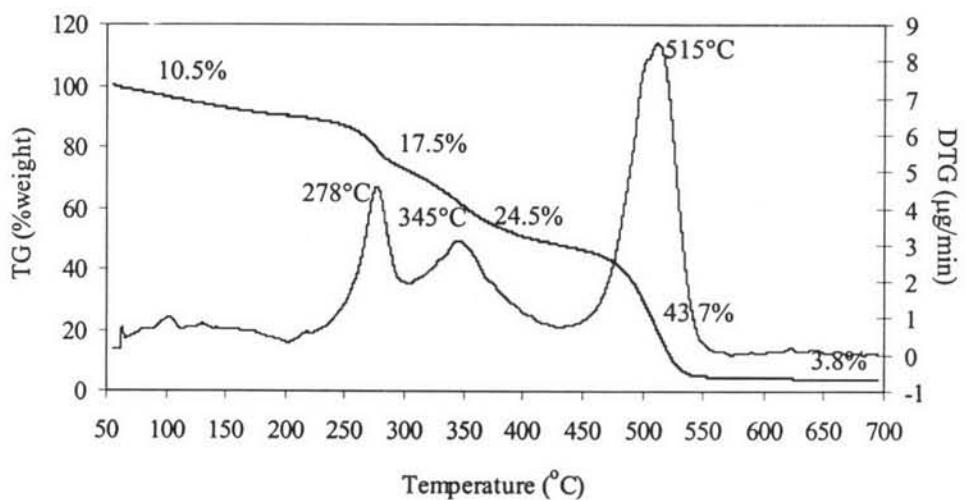
**Figure A16** TG/DTA curves of SS/PAM blend (20/80 w/w).



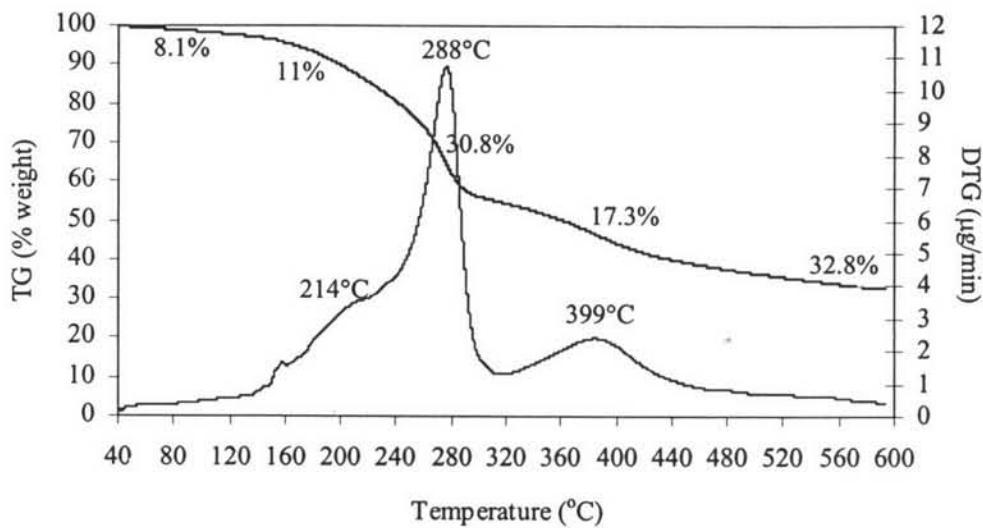
**Figure A17** TG/DTA curves of SS/PAM blend (30/70 w/w).



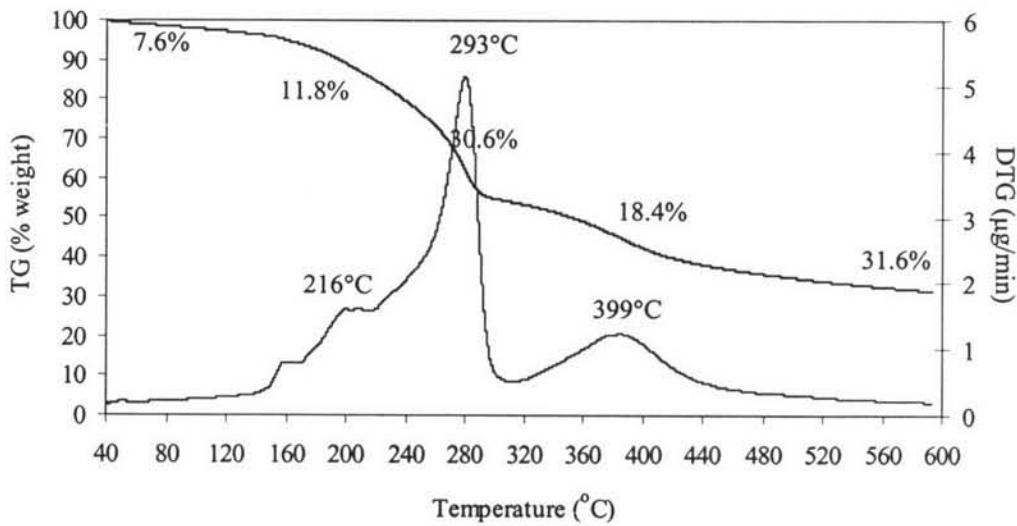
**Figure A18** TG/DTA curves of SS/PAM blend (40/60 w/w).



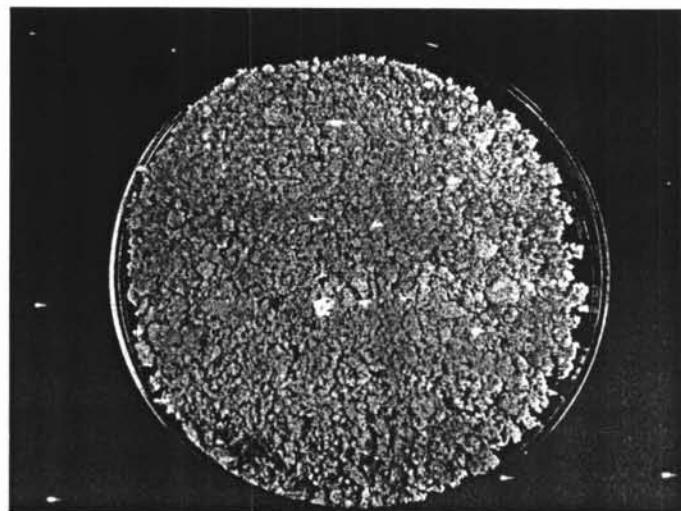
**Figure A19** TG/DTA curves of SS/PAM blend (50/50 w/w).



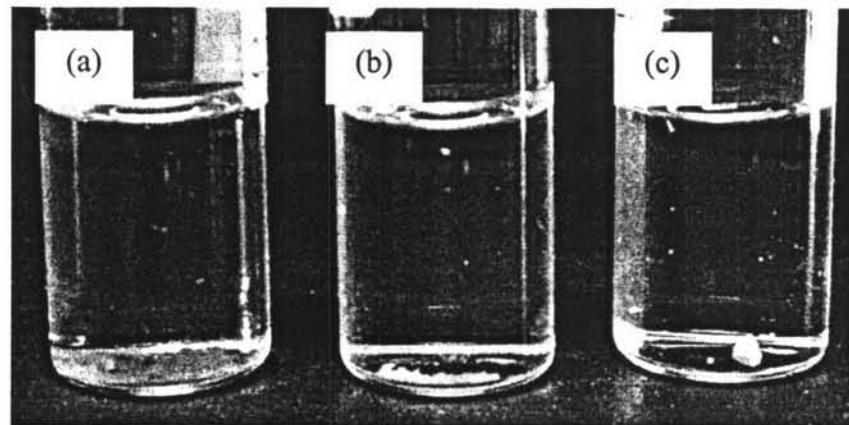
**Figure A20** TG/DTA curves of SS-PAM modification (1:5 w/w).



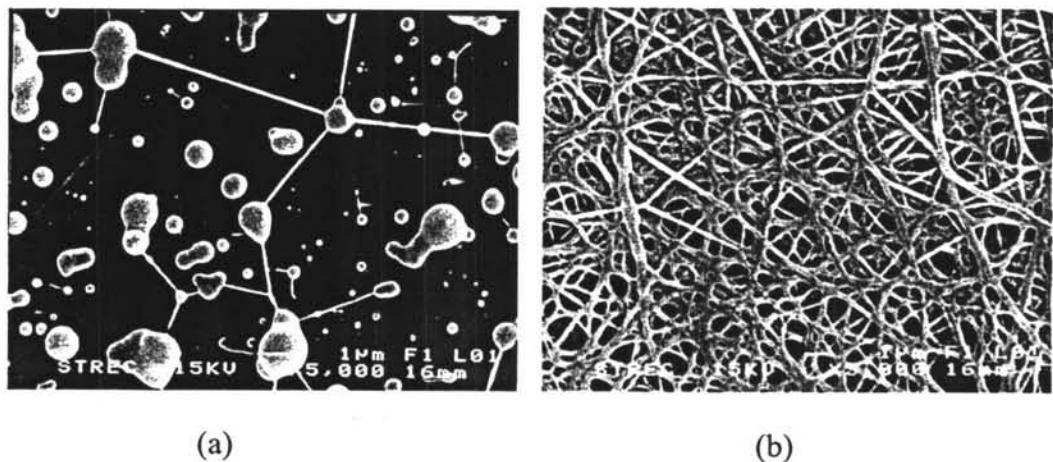
**Figure A21** TG/DTA curves of SS-PAM modification (1:10 w/w).



**Figure A22** Sericin powder.



**Figure A23** Solubility (in water) of SS-PAM modification 1:1 (a), 1:5 (b), 1:10 (c)  
w/w.



**Figure A24** SEM images (at magnification of 5000 and scale bar shown is for 1  $\mu\text{m}$ ) of electrospun from: (a) 40% (w/v) PAM in water; (b) 50 % (w/v) PAM in water. Applied electric field was 25 kV/15 cm.

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