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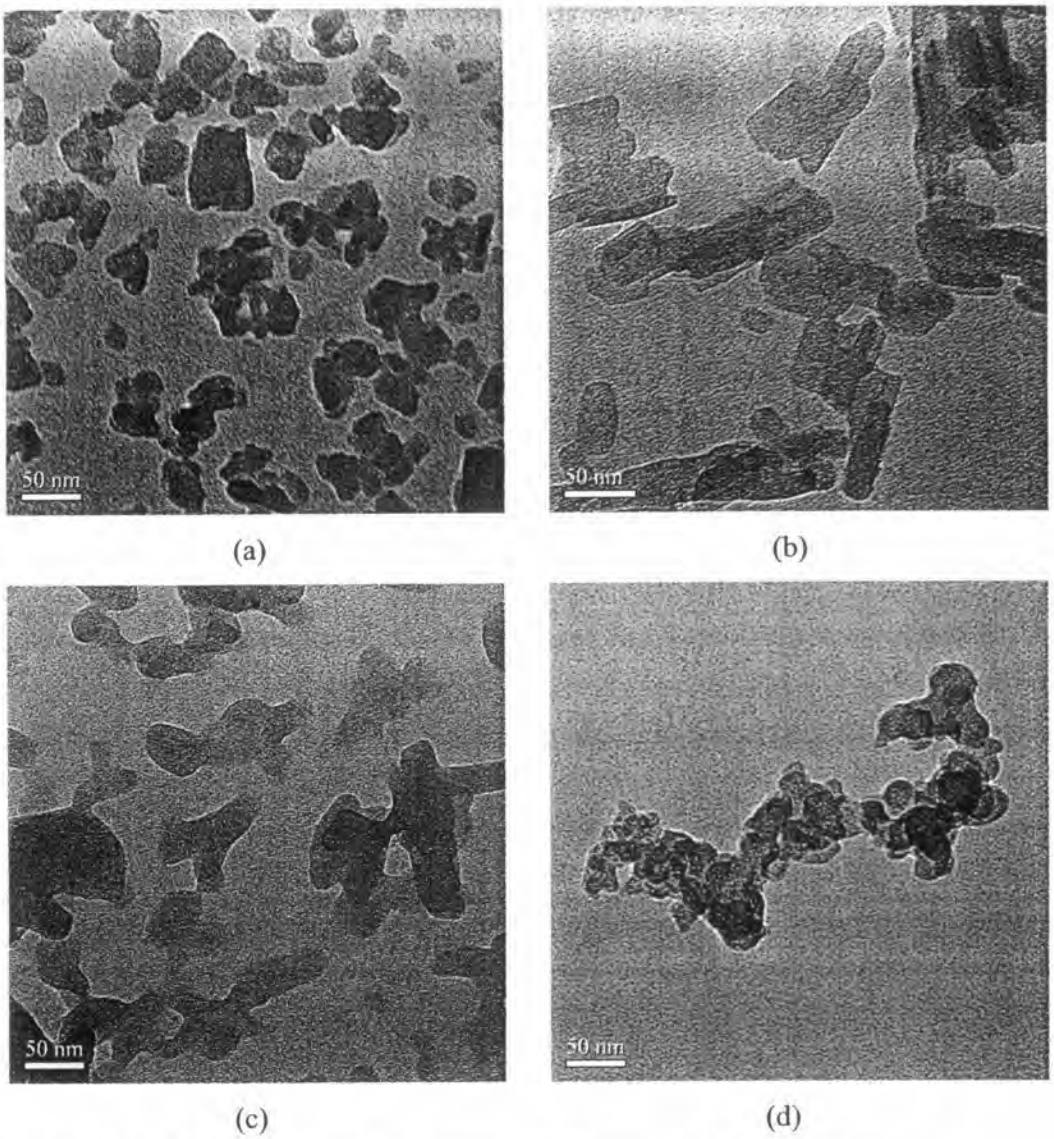
APPENDICES

APPENDIX A

TEM OF PIGMENT DISPERSIONS



(a) (b)

(c) (d)

Figure A1: TEM of (a) cyan, (b) magenta, (c) yellow, and (d) black pigment dispersions

APPENDIX B

CONDITION OF INK FIXATION

Table B1: Testing of steaming time and color strength of the printed fabrics

Time of steaming (min)	K/S			
	After steaming	After washing	Color change	Relative color strength
0	0.2942	0.2174	0.0768	0.7389
3	0.4143	0.3044	0.1099	0.7348
5	0.4486	0.3585	0.0901	0.7992
10	0.3201	0.2426	0.0775	0.7579

Table B2: Testing of steaming time and color strength of the printed fabrics

Time of steaming (min)	K/S			
	After steaming	After washing	Color change	Relative color strength
0	0.4011	0.3290	0.0721	0.8202
3	0.3987	0.3410	0.0577	0.8552
5	0.3755	0.3590	0.0166	0.9559
10	0.4196	0.3674	0.0522	0.8757

Table B3: Testing of the concentration of sodium chloride and color strength of the printed fabrics

NaCl (% w/v)	K/S			
	After soaking	After washing	Color change	Relative color strength
0	0.4028	0.2726	0.1301	0.6769
5	0.4396	0.3089	0.1307	0.7027
10	0.4153	0.2839	0.1314	0.6836
20	0.4158	0.2939	0.1219	0.7068

Table B4: Testing of the concentration of sodium chloride and color strength of the printed fabrics (Testing 1)

NaCl (% w/v)	K/S			
	After soaking	After washing	Color change	Relative color strength
0	0.3974	0.3290	0.0684	0.8280
5	0.4200	0.3506	0.0694	0.8348
10	0.4130	0.3440	0.0690	0.8330
15	0.4201	0.3087	0.1113	0.7350
20	0.4413	0.3587	0.0826	0.8129

Repeat: Testing 2, repeated test

NaCl (% w/v)	K/S			
	After soaking	After washing	Color change	Relative color strength
0	0.3974	0.3290	0.0684	0.8280
5	0.3051	0.2617	0.0435	0.8575
10	0.3143	0.2412	0.0731	0.7673
15	0.3450	0.2698	0.0752	0.7821
20	0.3284	0.2808	0.0475	0.8552

The color change and relative color strength were calculated form;

$$\text{Color change} = (K/S)_{\text{before washing}} - (K/S)_{\text{after washing}} \quad \text{(B1)}$$

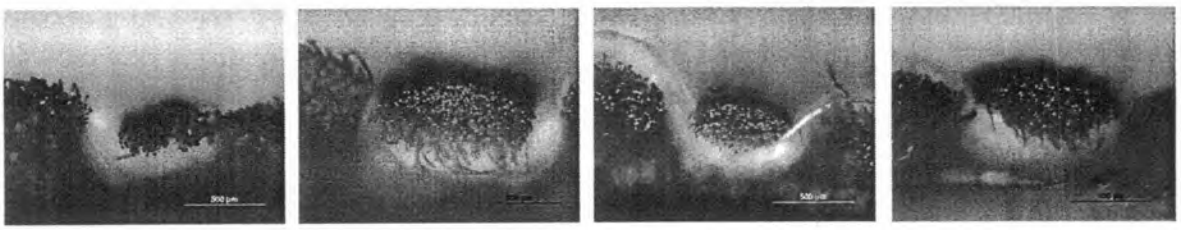
$$\text{Relative color strength} = (K/S)_{\text{after washing}} / (K/S)_{\text{before washing}} \quad \text{(B2)}$$

From the above results, the fabric fixation time to obtain optimum relative color strength before washing was 5-min steaming and the soaking time in NaCl solution (5% w/v) prior to washing was 20 min.

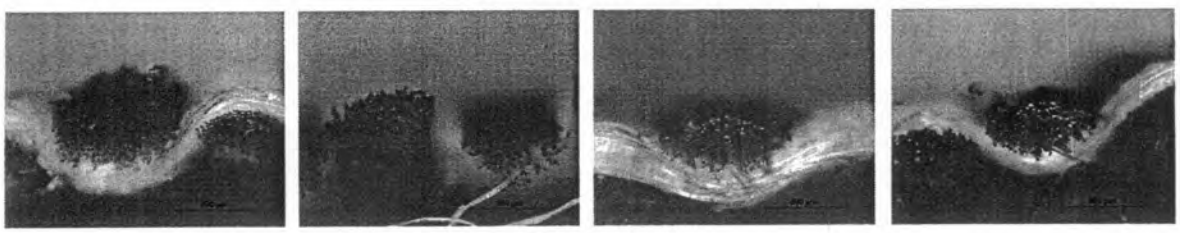
APPENDIX C

IMAGES OF THE CROSS

SECTIONALLY PRINTED FABRICS

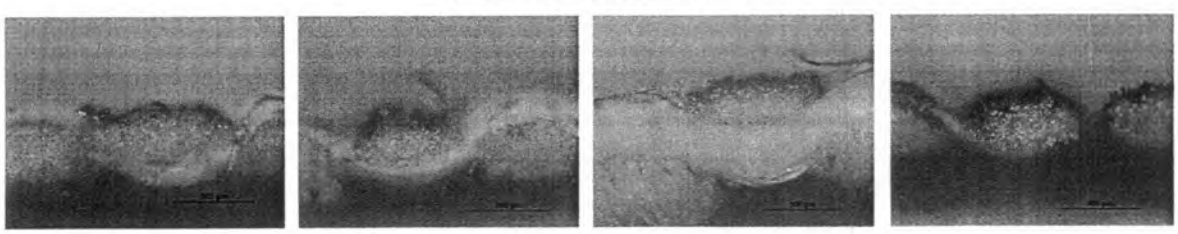


a) Non-treated fabric

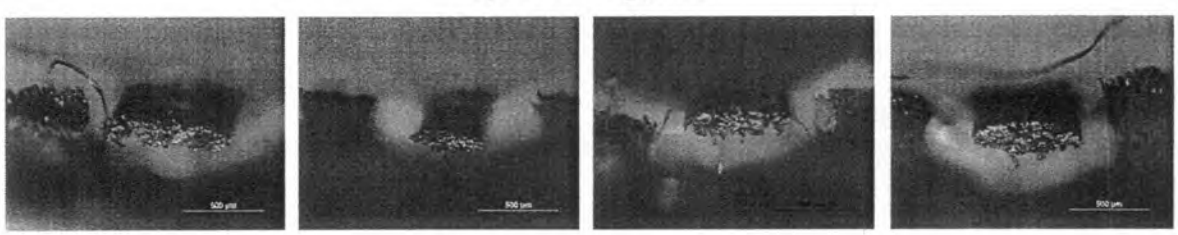


b) 10% w/v serine

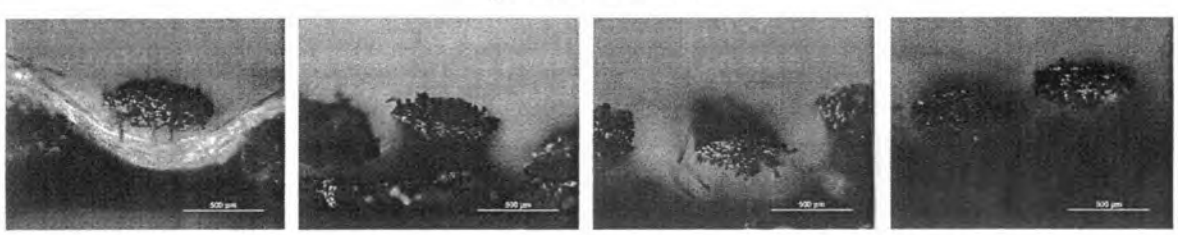
c) 5% w/v aspartic acid



d) 20% w/v glycine



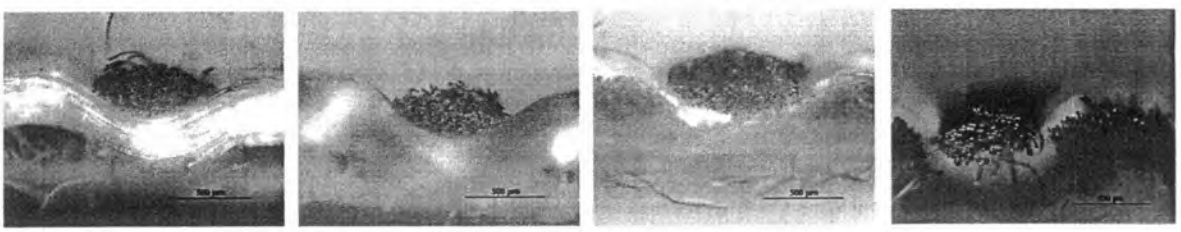
e) 15% w/v sericin



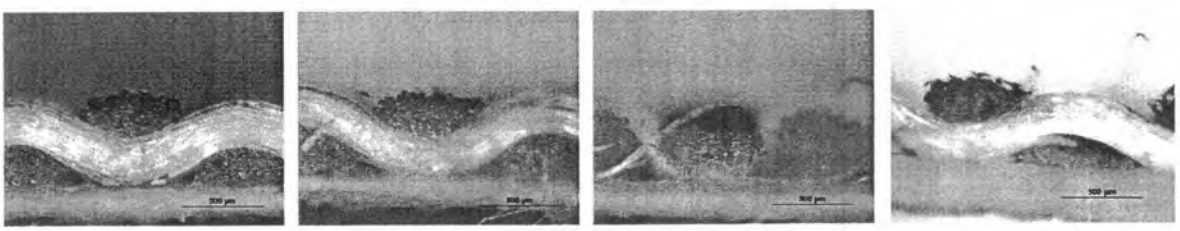
f) 2% w/v FM-80

g) 10% sanfix 555

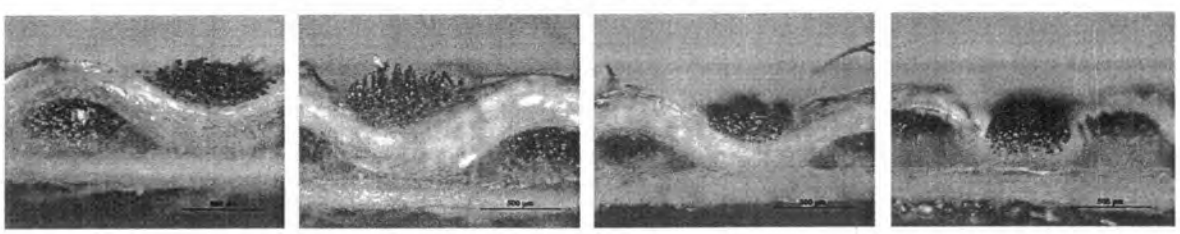
Figure C1: Cross-sectional images of the treated silk fibers in the warp direction



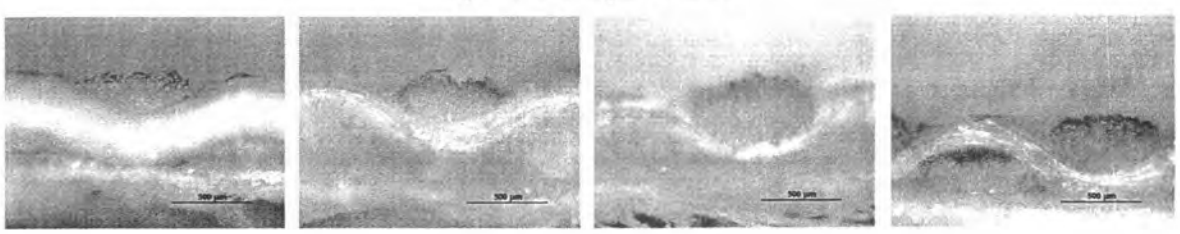
a) Non-treated fabric



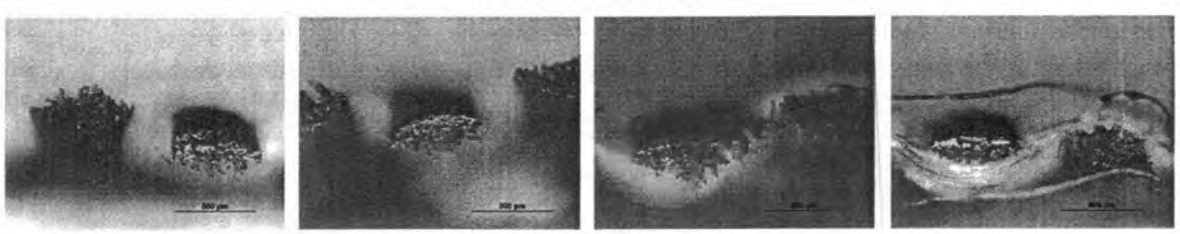
b) 10% w/v serine



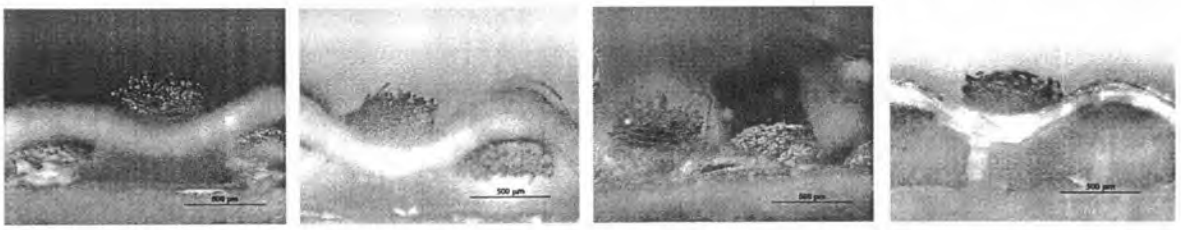
c) 5% w/v aspartic acid



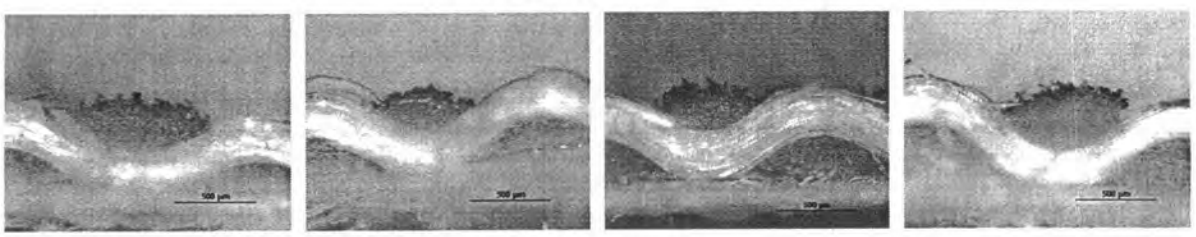
d) 20% w/v glycine



e) 15% w/v sericin



f) 2% w/v FM-80



g) 10% sanfix 555

Figure C2: Cross-sectional images of the treated silk fiber in the weft direction.

APPENDIX D

COLOR GAMUT OF PRINTED FABRICS

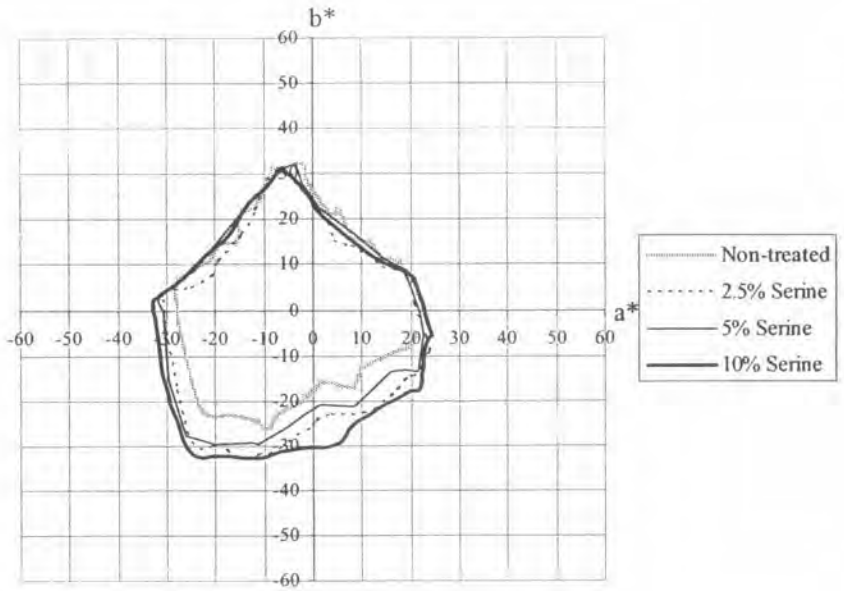


Figure D1: a* - b* diagram of the non-treated silk and the silk coated with serine at various concentrations

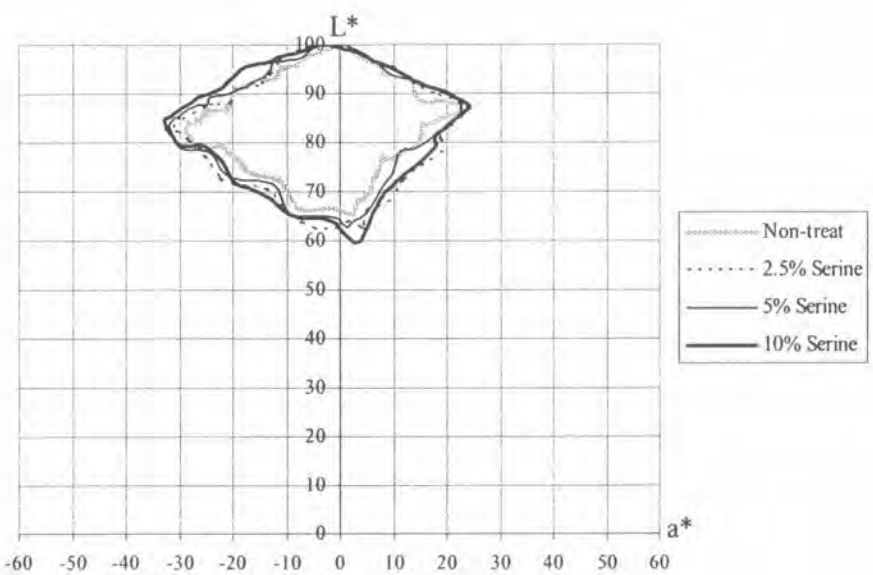


Figure D2: L* - a* diagram of the non-treated silk and the silk coated with serine at various concentrations

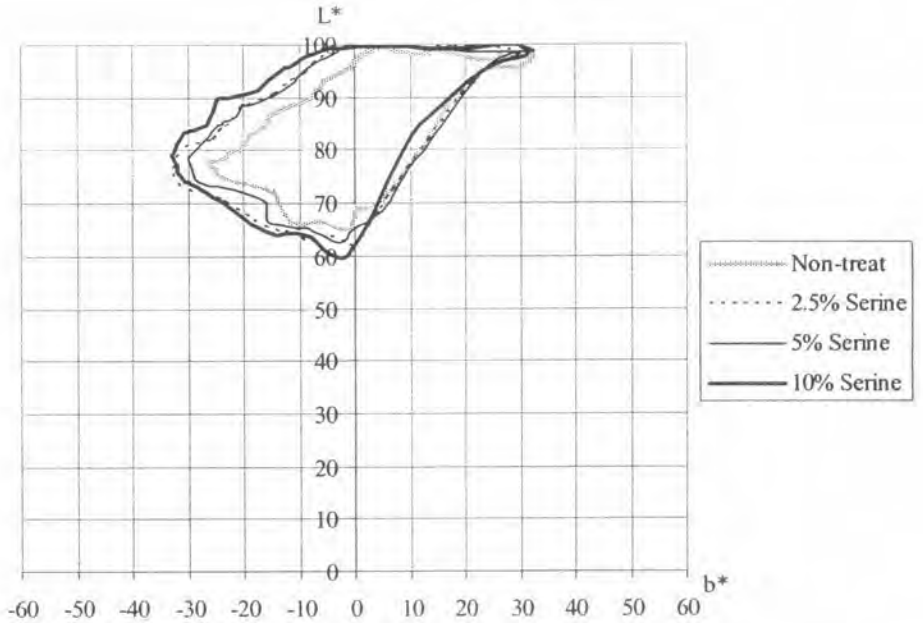


Figure D3: L* - b* diagram of the non-treated silk and the silk coated with serine at various concentrations

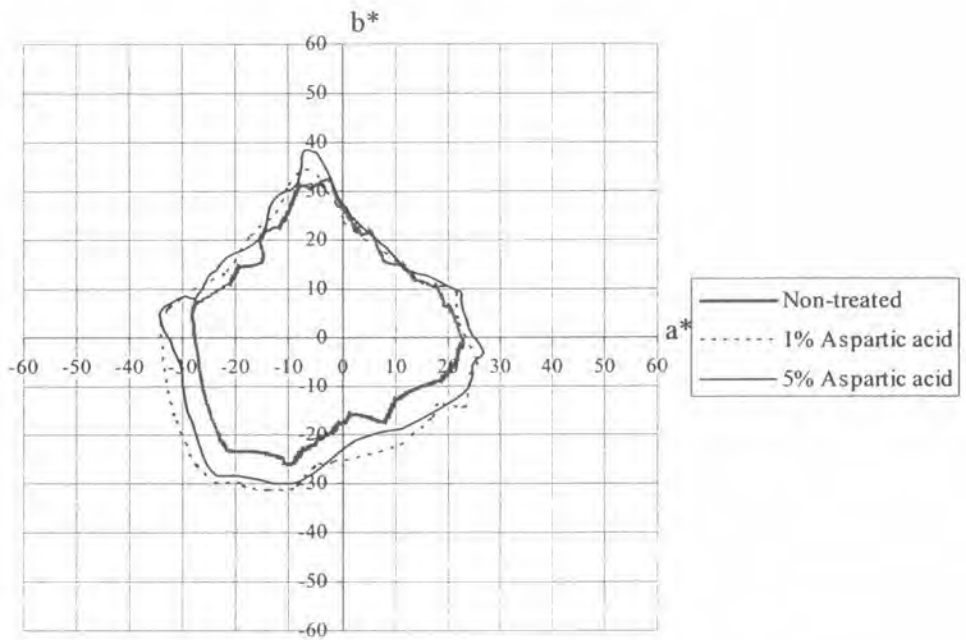


Figure D4: a* - b* diagram of the nontreated silk and the silk coated with aspartic acid at various concentrations

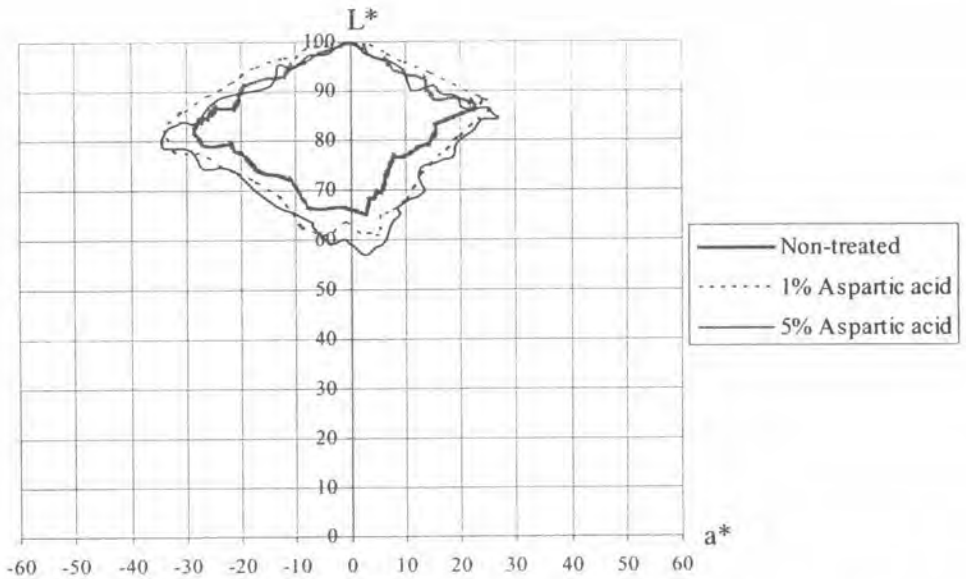


Figure D5: L* - a* diagram of the non-treated silk and the silk coated with aspartic acid at various concentrations

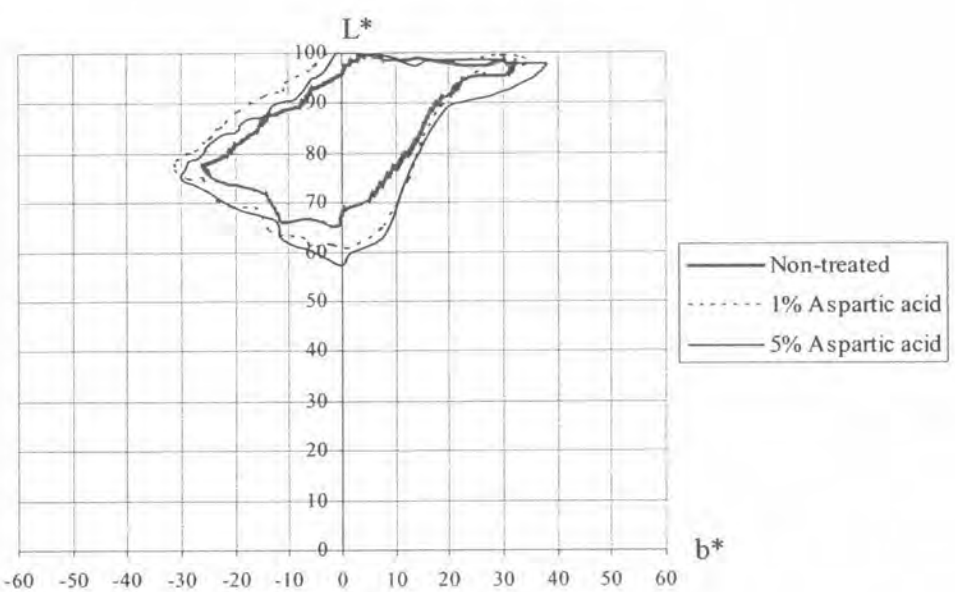


Figure D6: L* - b* diagram of the non-treated silk and the silk coated with aspartic acid at various concentrations

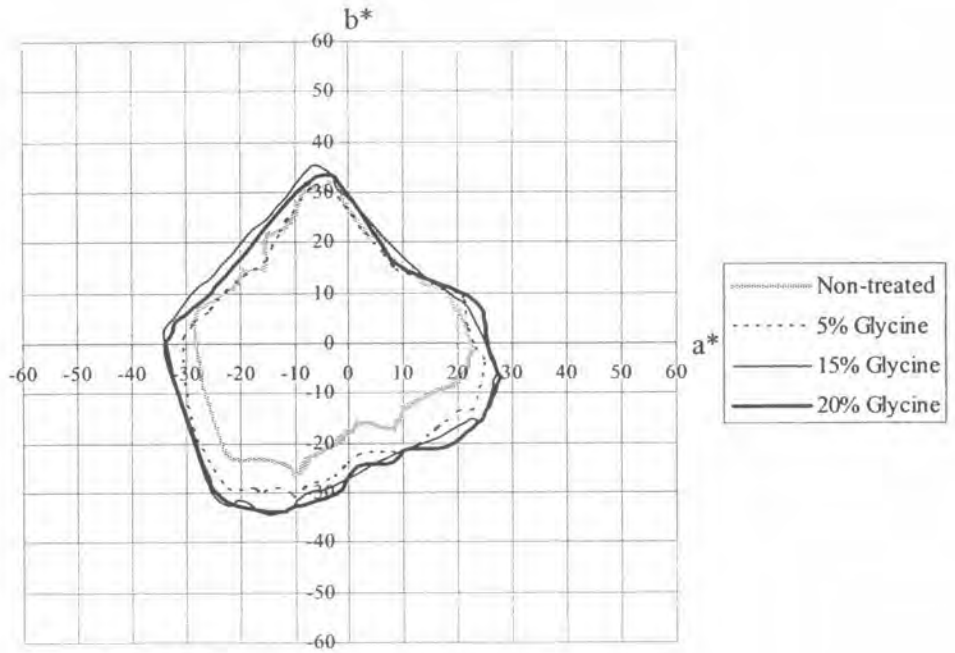


Figure D7: a* - b* diagram of the non-treated silk and the silk coated with glycine at various concentrations

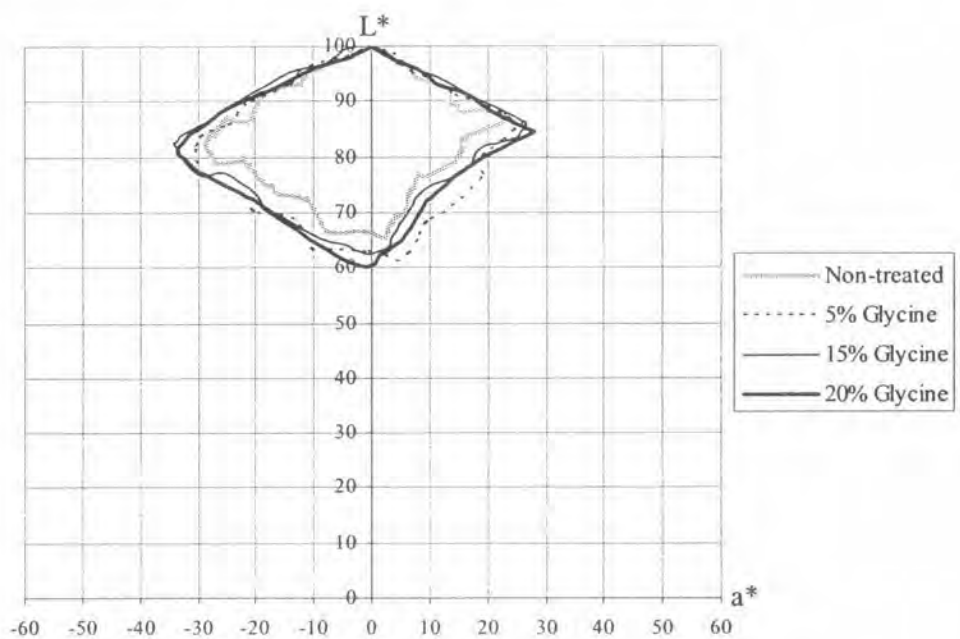


Figure D8: L* - a* diagram of the non-treated silk and the silk coated with glycine at various concentrations

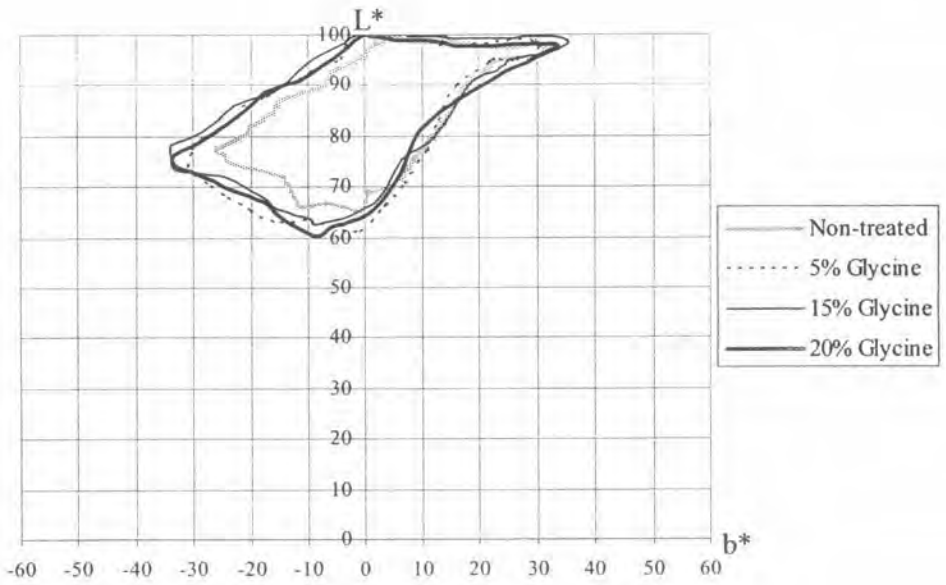


Figure D9: L* - b* diagram of the non-treated silk and the silk coated with glycine at various concentrations

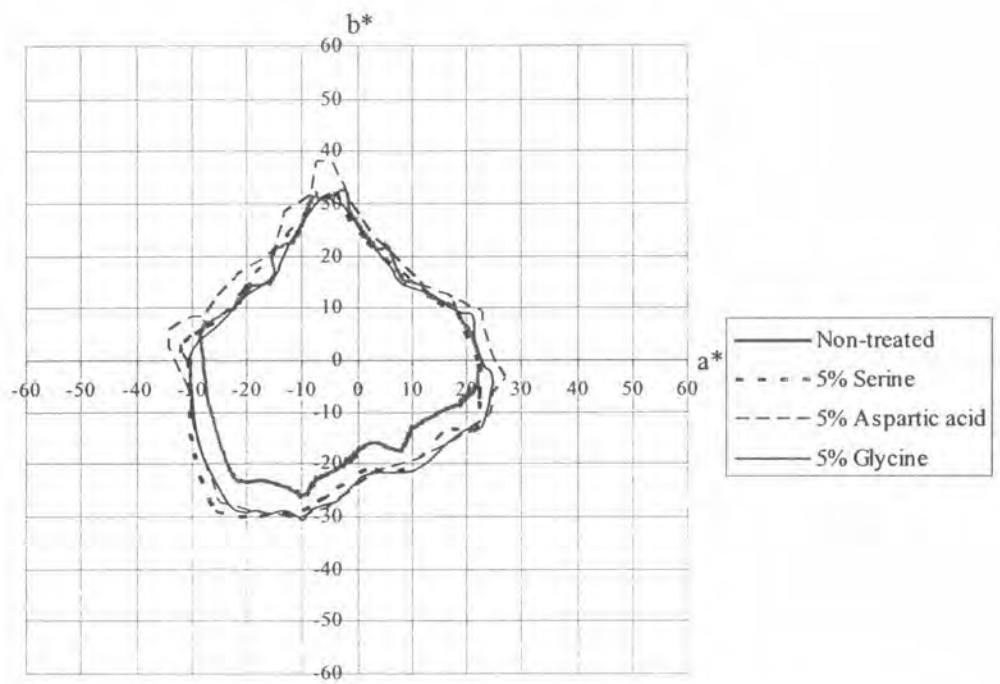


Figure D10: a* - b* diagram of the non-treated silk and the silk coated with amino acids at 5% w/v

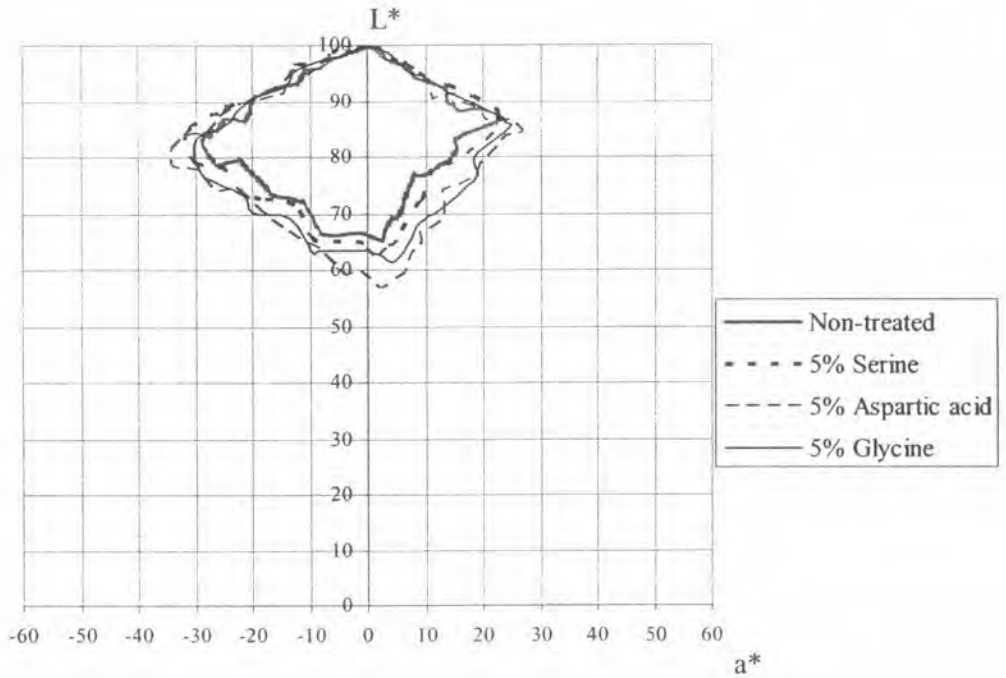


Figure D11: L* - b* diagram of the non-treated silk and the silk coated with amino acids at 5% w/v

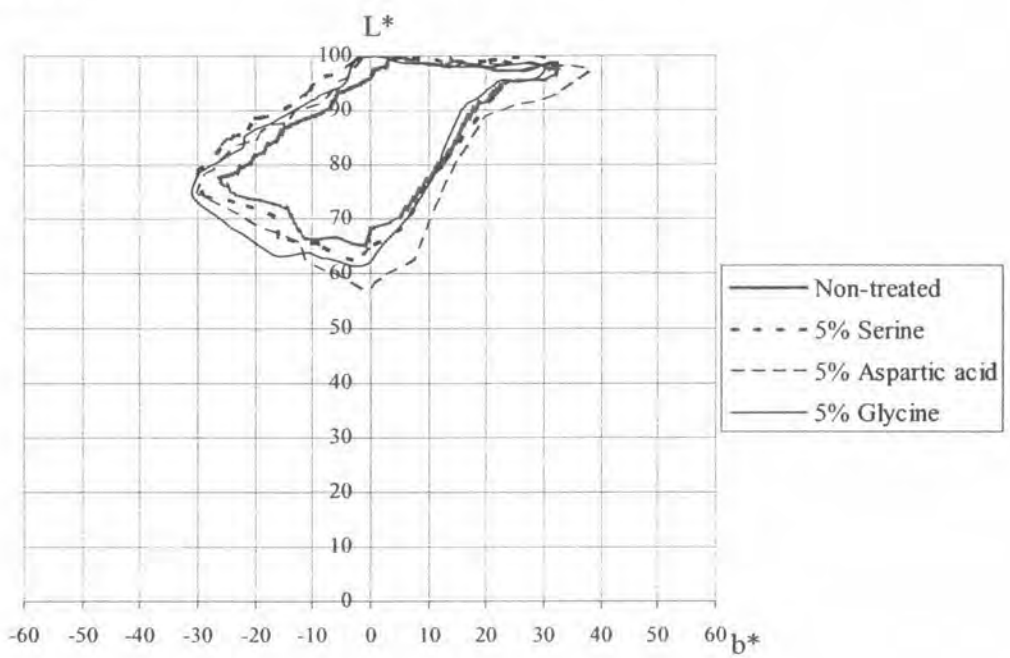


Figure D12: L* - b* diagram of the non-treated silk and the silk coated with amino acids at 5% w/v

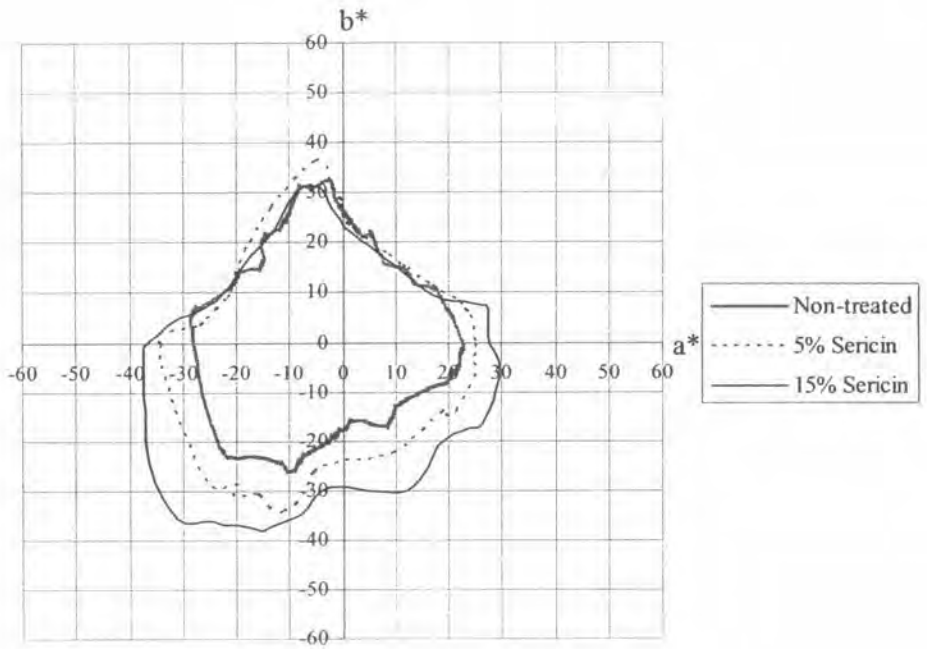


Figure D13: a* - b* diagram of the non-treated silk and the silk coated with sericin at various concentrations

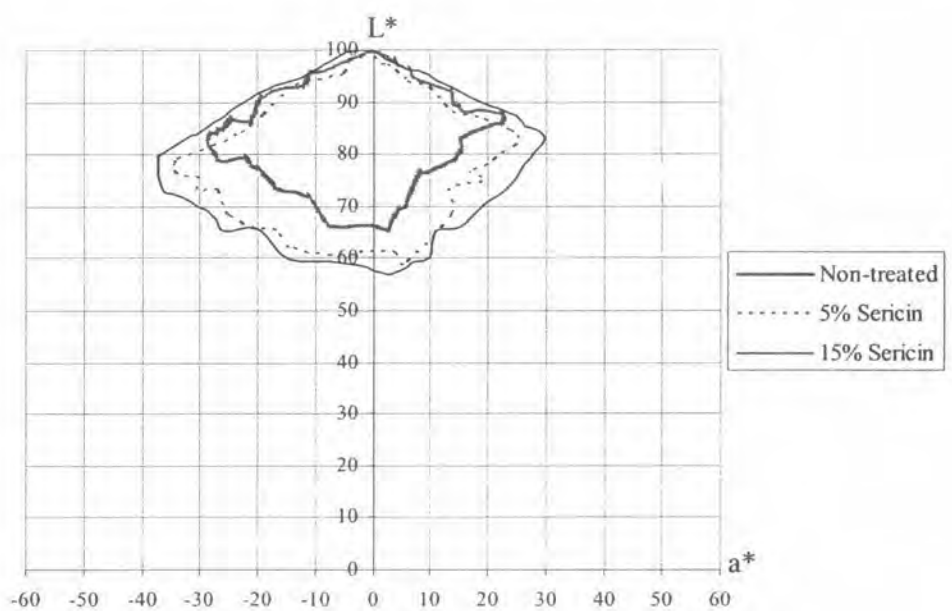


Figure D14: L* - a* diagram of the non-treated silk and the silk coated with sericin at various concentrations

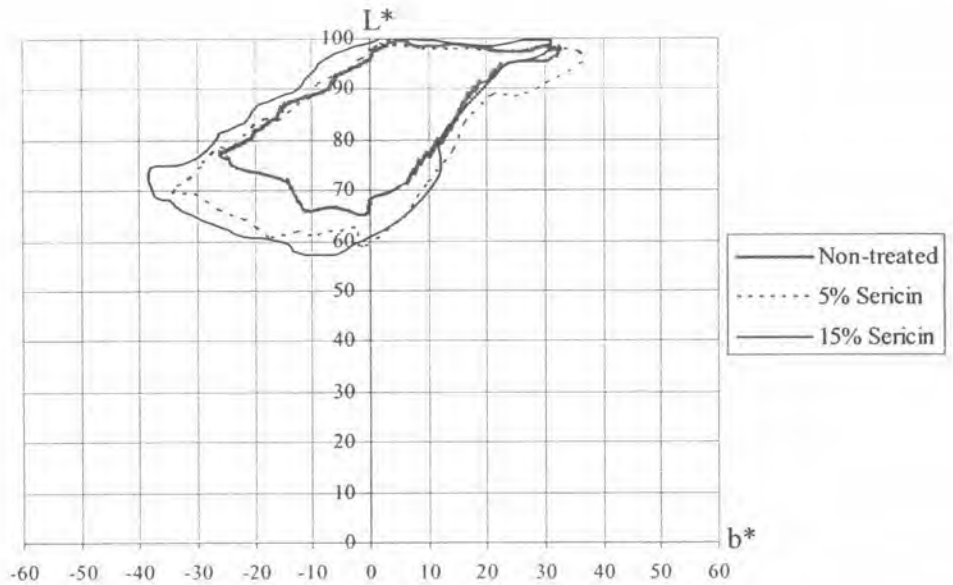


Figure D15: L* - b* diagram of the non-treated silk and the silk coated with sericin at various concentrations

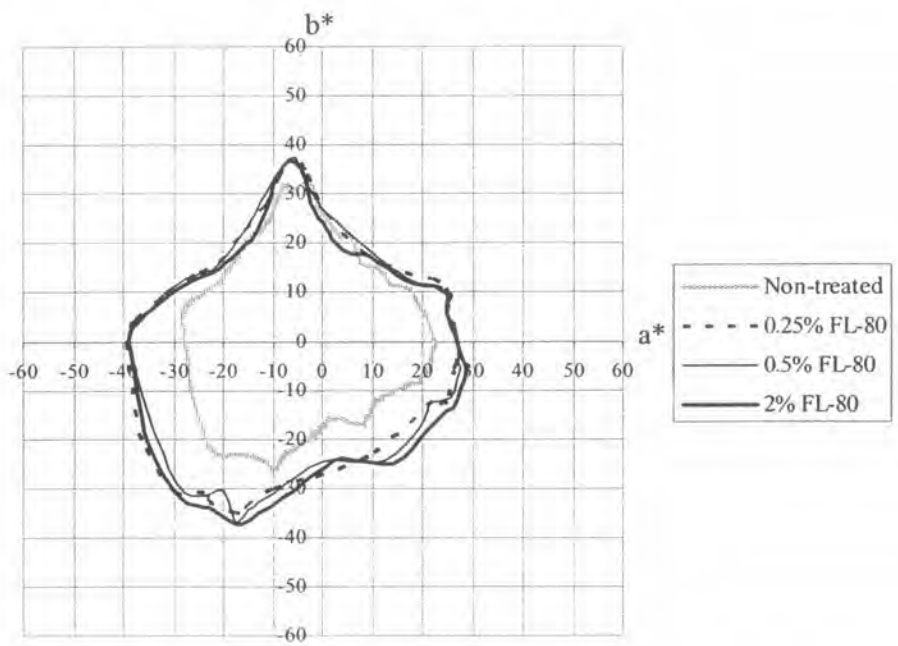


Figure D16: a* - b* diagram of the non-treated silk and the silk coated with chitosan (FL-80), MW = 1.2×10^5 at various concentrations

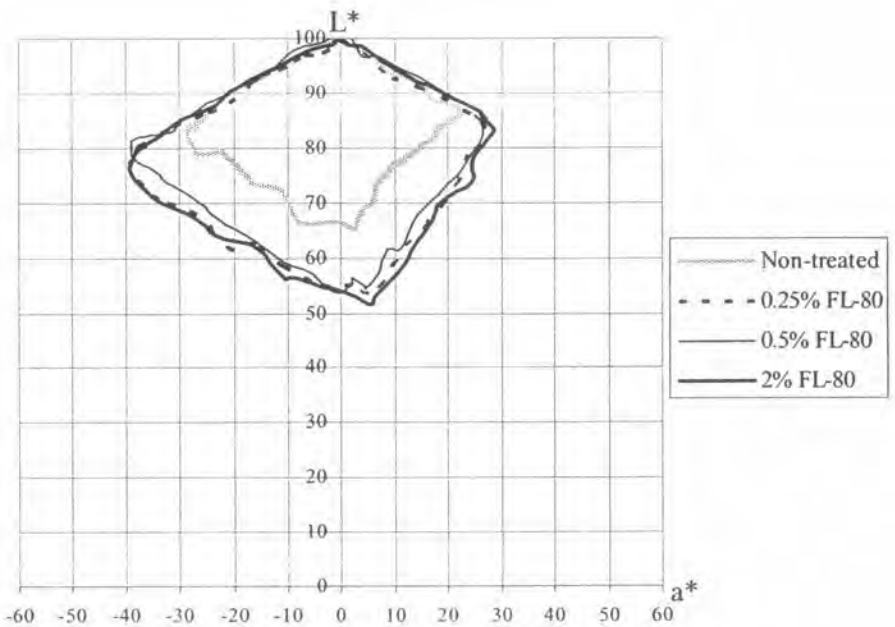


Figure D17: L* - a* diagram of the non-treated silk and the silk coated with chitosan (FL-80), MW = 1.2 x 10^5 at various concentrations

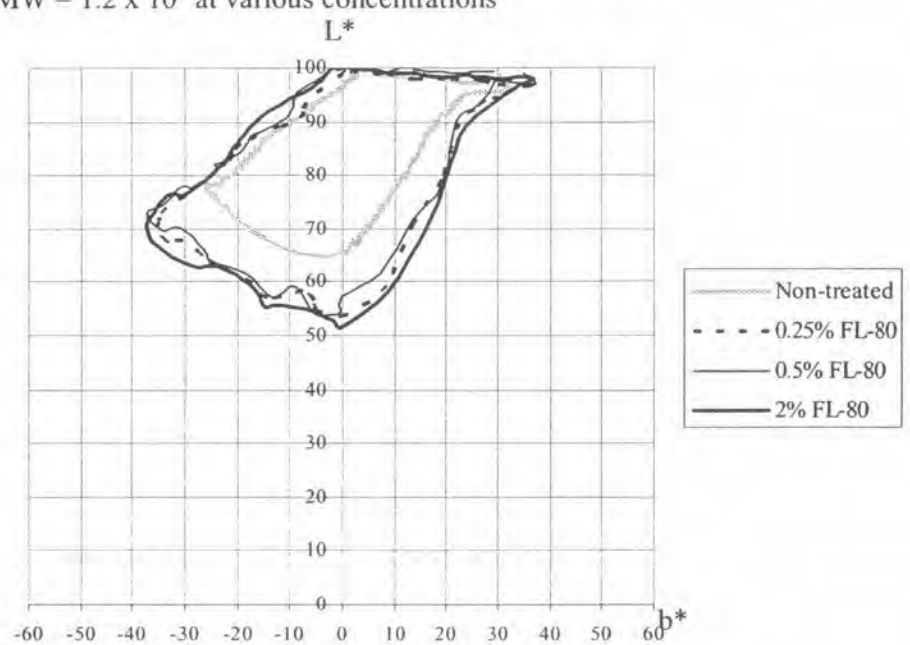


Figure D18: L* - b* diagram of the non-treated silk and the silk coated with chitosan (FL-80), MW = 1.2 x 10^5 at various concentrations

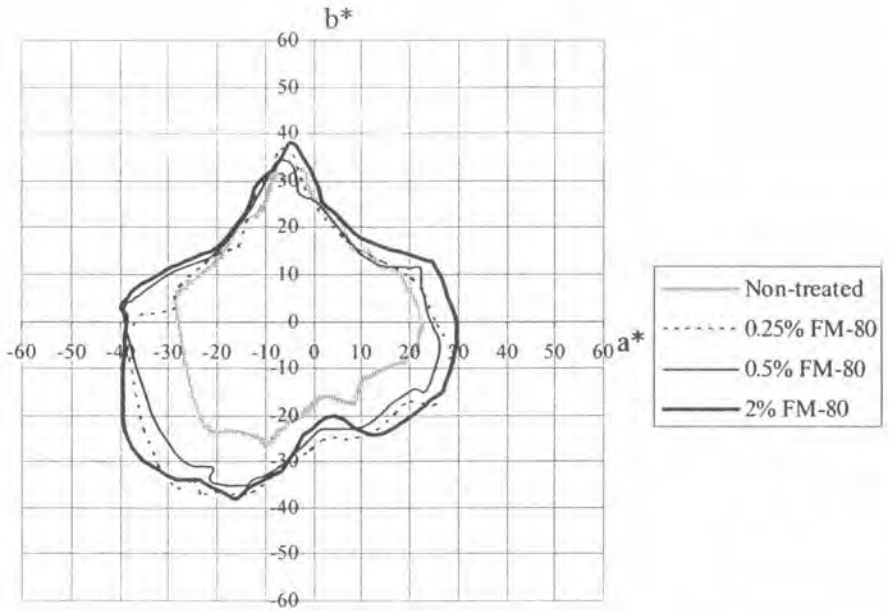


Figure D19: a* - b* diagram of the nontreated silk and the silk coated with chitosan (FM-80), MW = 3.7 x 10^5 at various concentrations

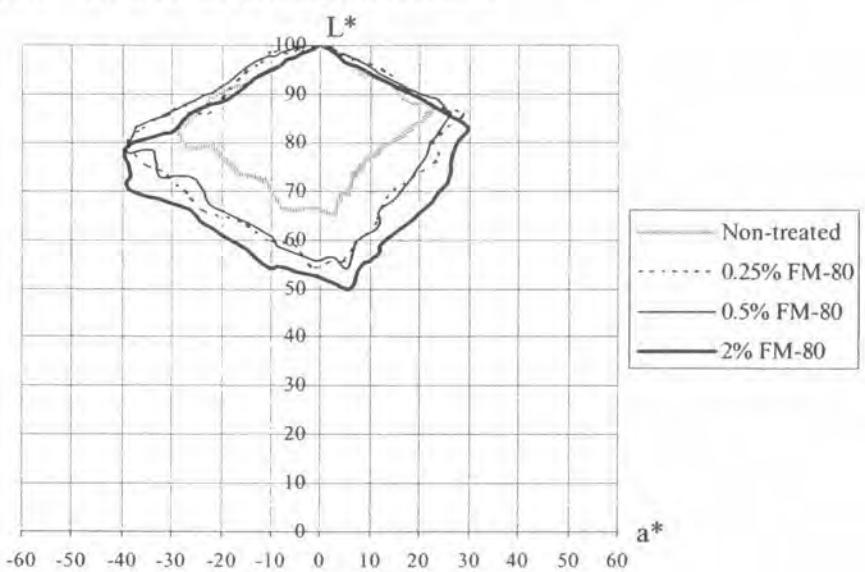


Figure D20: L* - a* diagram of the non-treated silk and the silk coated with chitosan (FM-80), MW = 3.7 x 10^5 at various concentrations

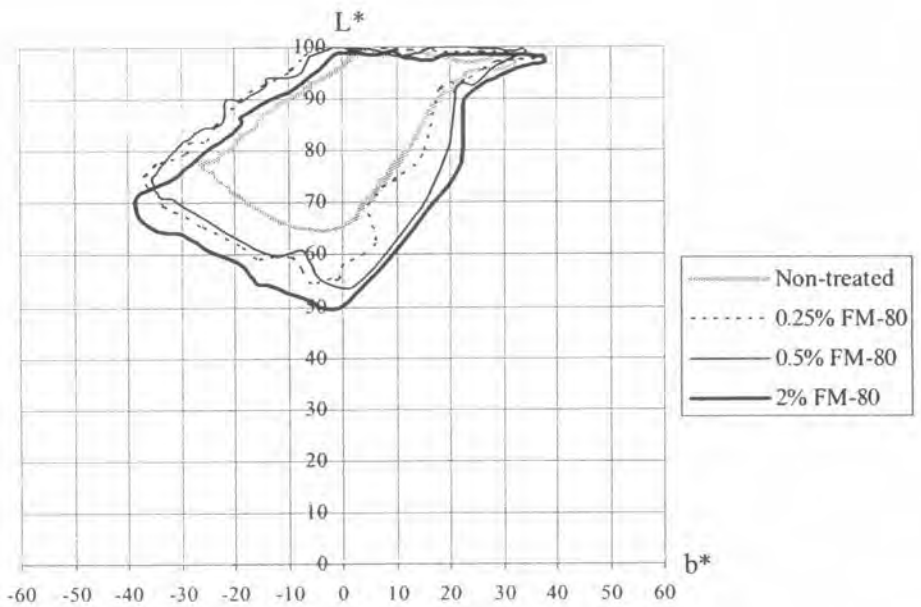


Figure D21: L* - b* diagram of the non-treated silk and the silk coated with chitosan (FM-80), MW = 3.7 x 10^5 at various concentrations

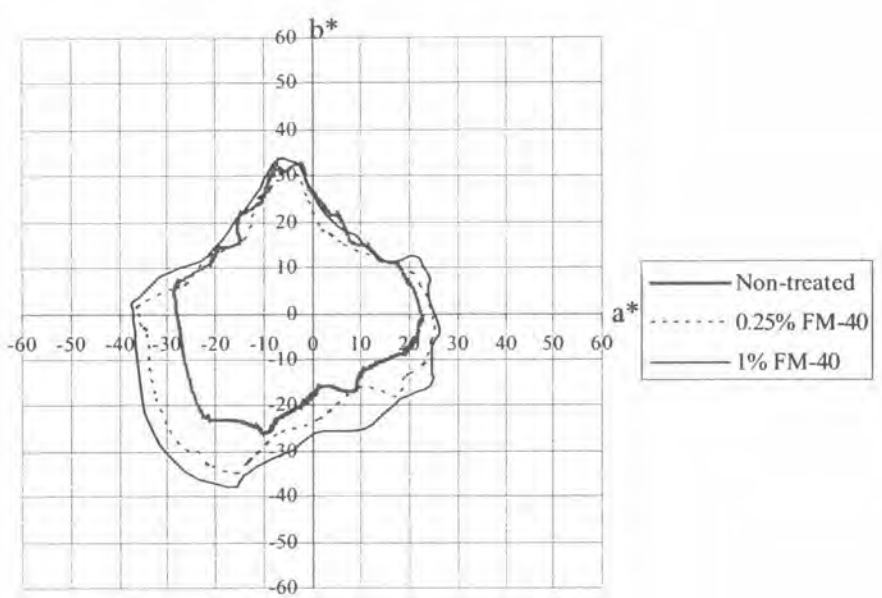


Figure D22: a* - b* diagram of the non-treated silk and the silk coated with chitosan (FM-40), MW = 8.5 x 10^5 at various concentrations

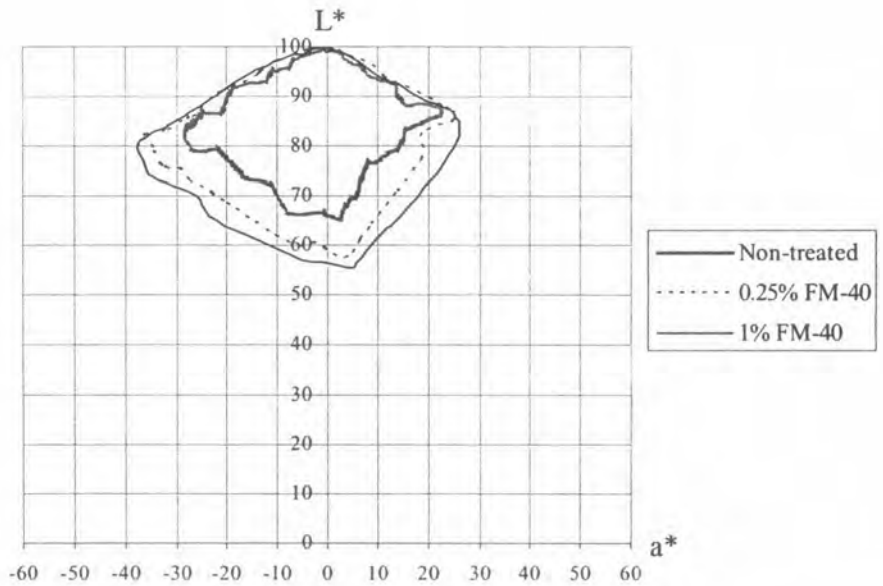


Figure D23: L* - a* diagram of the non-treated silk and the silk coated with chitosan (FM-40), MW = 8.5 x 10^5 at various concentrations

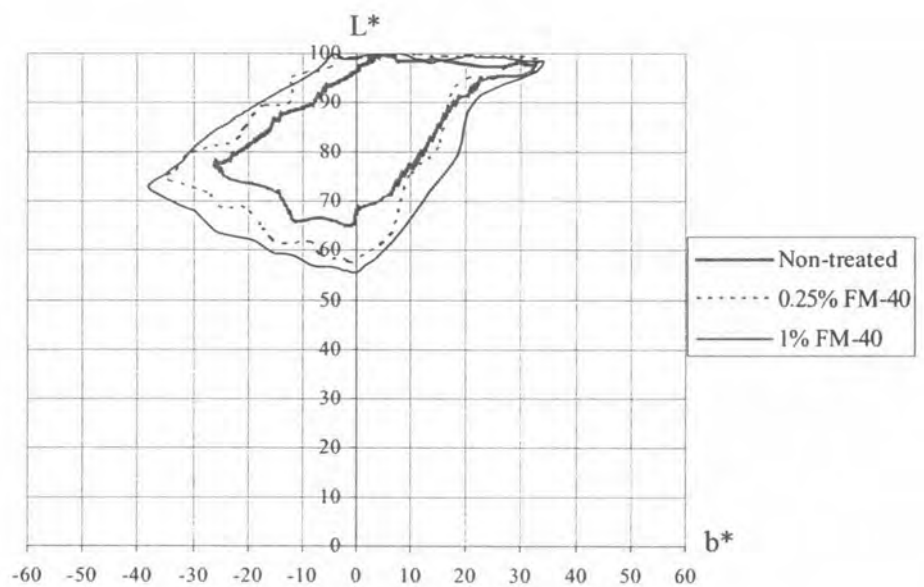


Figure D24: L* - b* diagram of the non-treated silk and the silk coated with chitosan (FM-40), MW = 8.5 x 10^5 at various concentrations

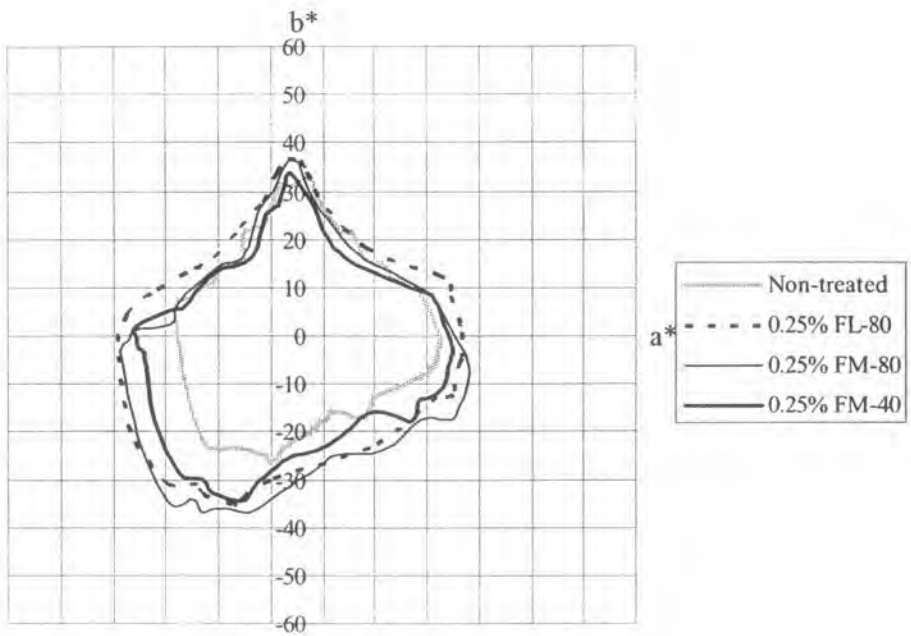


Figure D25: a* - b* diagram of the non-treated silk and the silk coated with 0.25%w/v various molecular weights of the chitosans

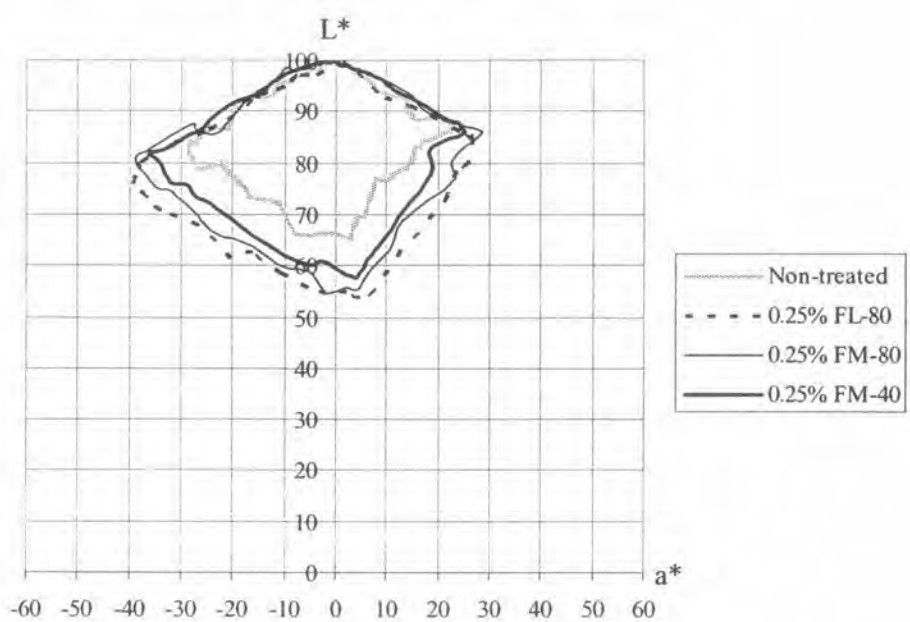


Figure D26: L* - a* diagram of the non-treated silk and the silk coated with 0.25%w/v various molecular weights of the chitosans

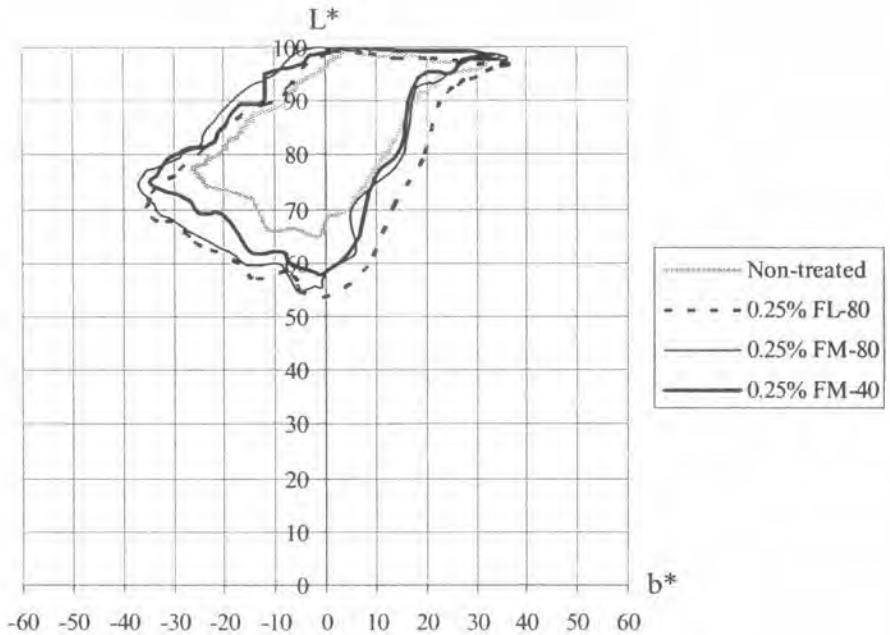


Figure D27: L* - b* diagram of the non-treated silk and the silk coated with 0.25%w/v various molecular weights of the chitosan

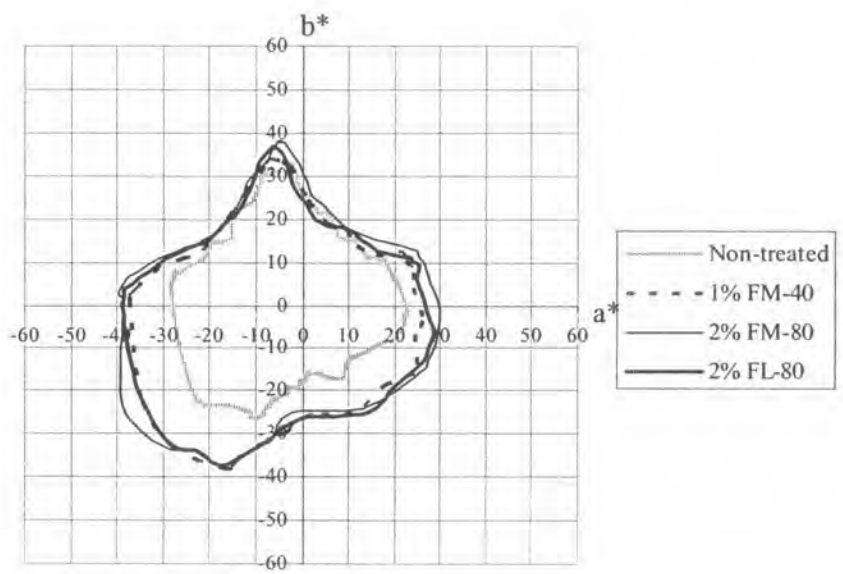


Figure D28: a* - b* diagram of the non-treated silk and the silk coated with various molecular weights of chitosan at the highest concentrations

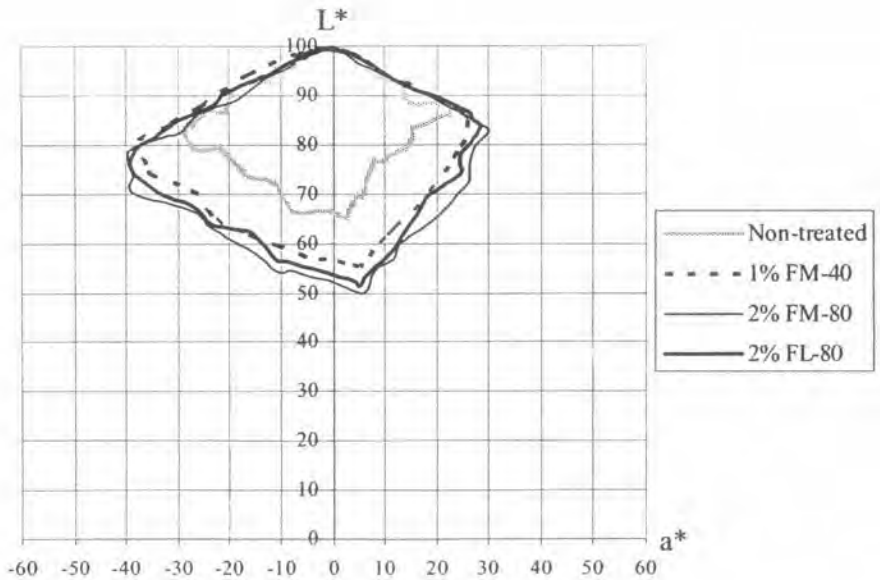


Figure D29: L* - a* diagram of the non-treated silk and the silk coated various molecular weights of chitosan at the highest concentrations

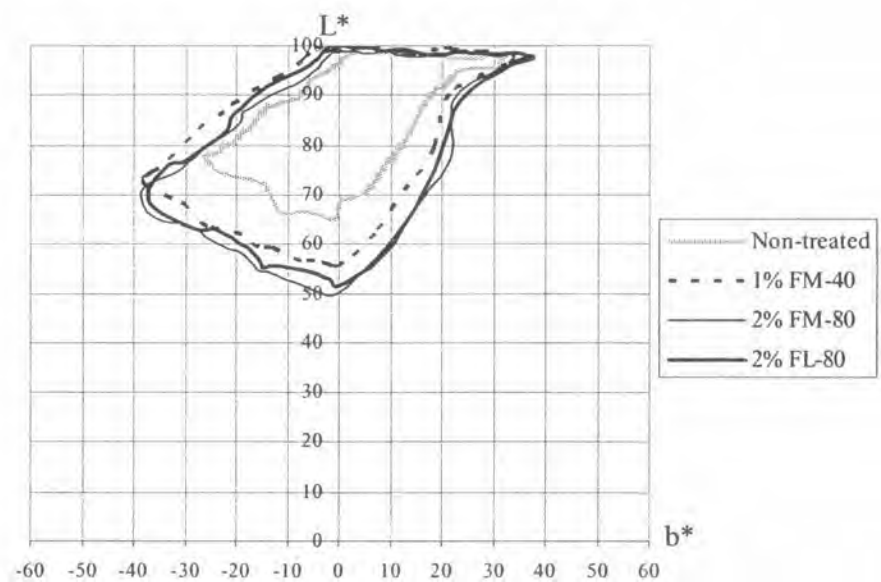


Figure D30: L* - b* diagram of the non-treated silk and the silk coated with various molecular weights of chitosan at the highest concentrations

APPENDIX E

CROCK FASTNESS OF THE PRINTED SILKS

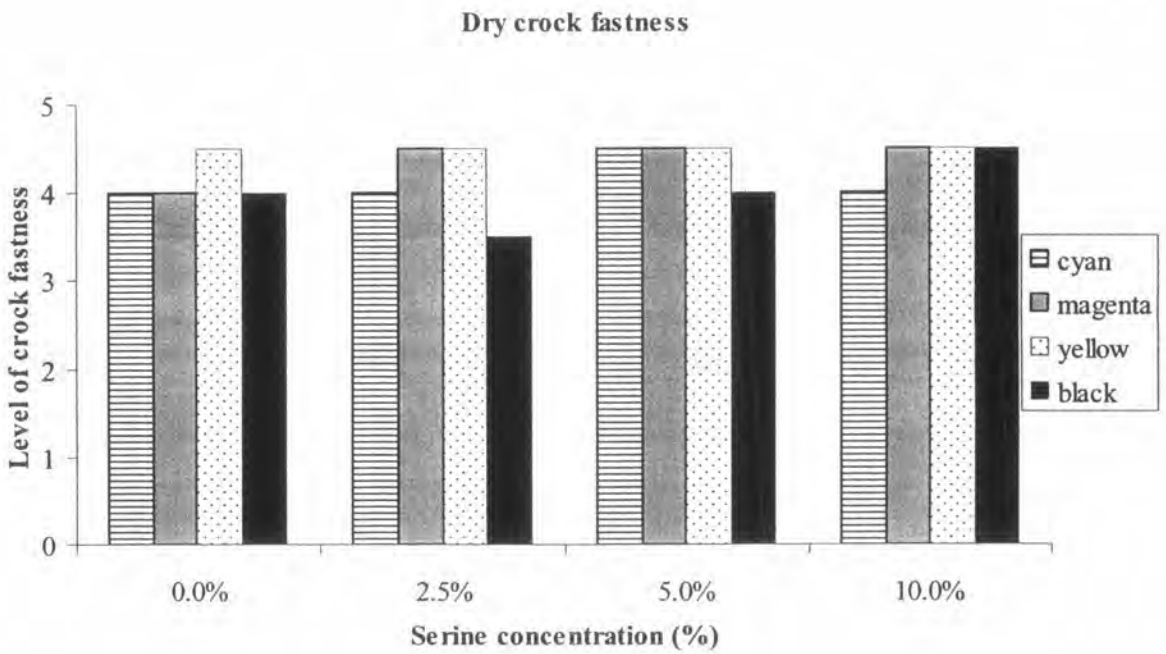


Figure E1: Dry crockfastness of the non-treated silk and silk coated with serine at various concentrations

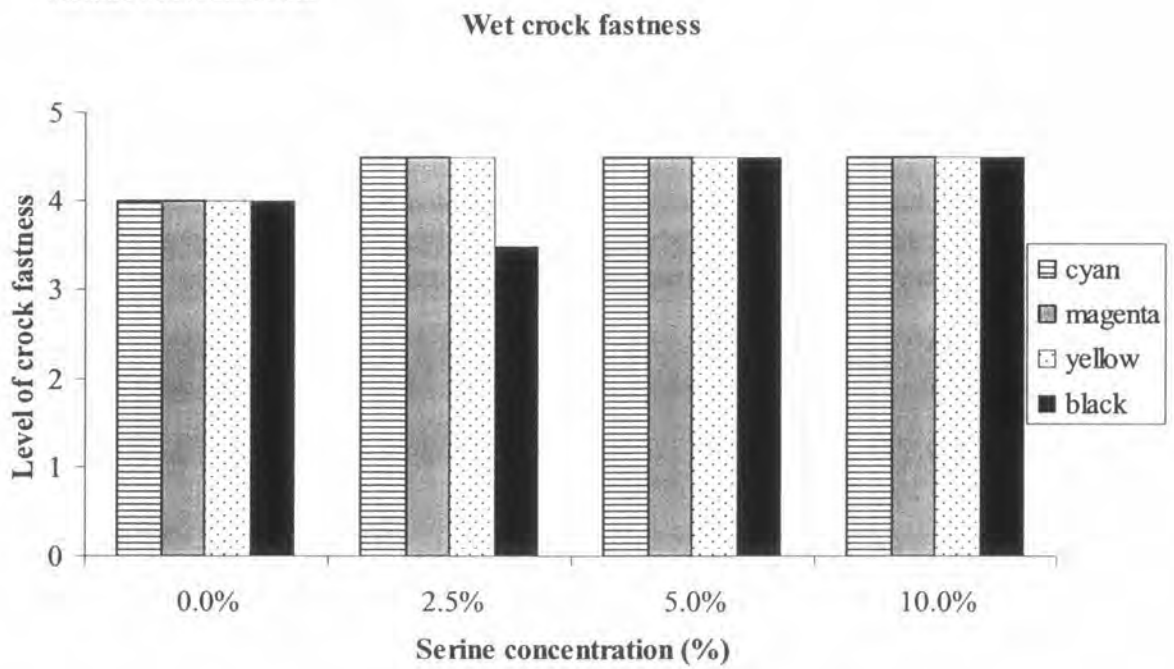


Figure E2: Wet crockfastness of the non-treated silk and silk coated with serine at various concentrations

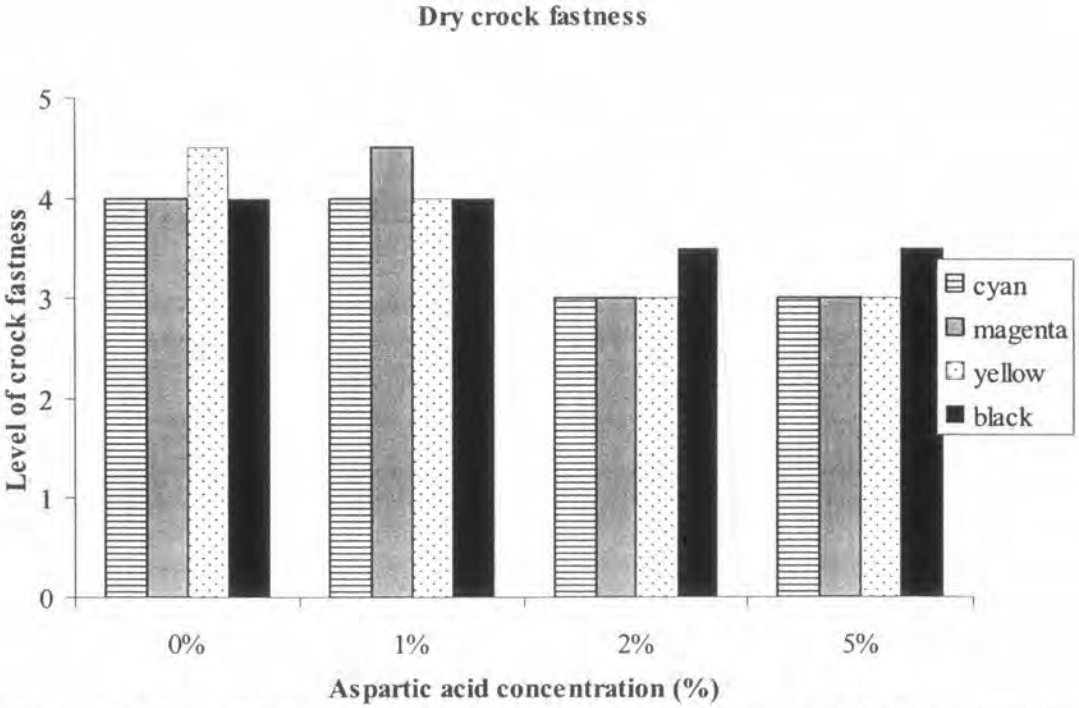


Figure E3: Dry crockfastness of the non-treated silk and silk coated with aspartic acid at various concentrations

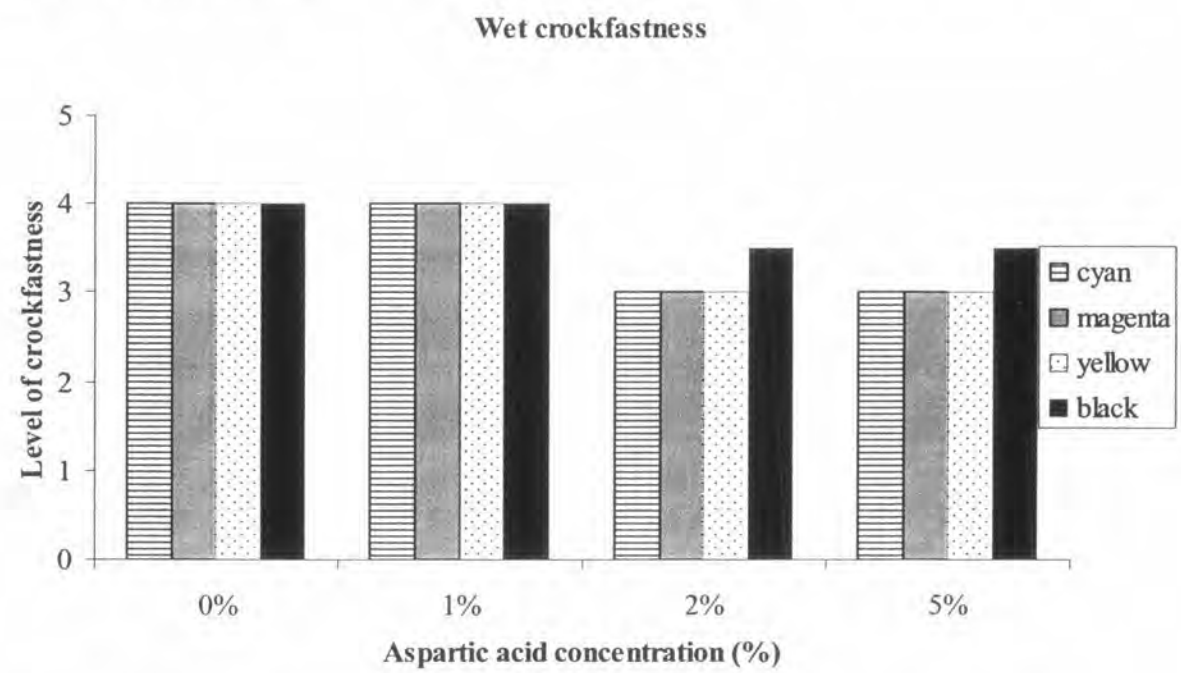


Figure E4: Wet crockfastness of the non-treated silk and silk coated with aspartic acid at various concentrations

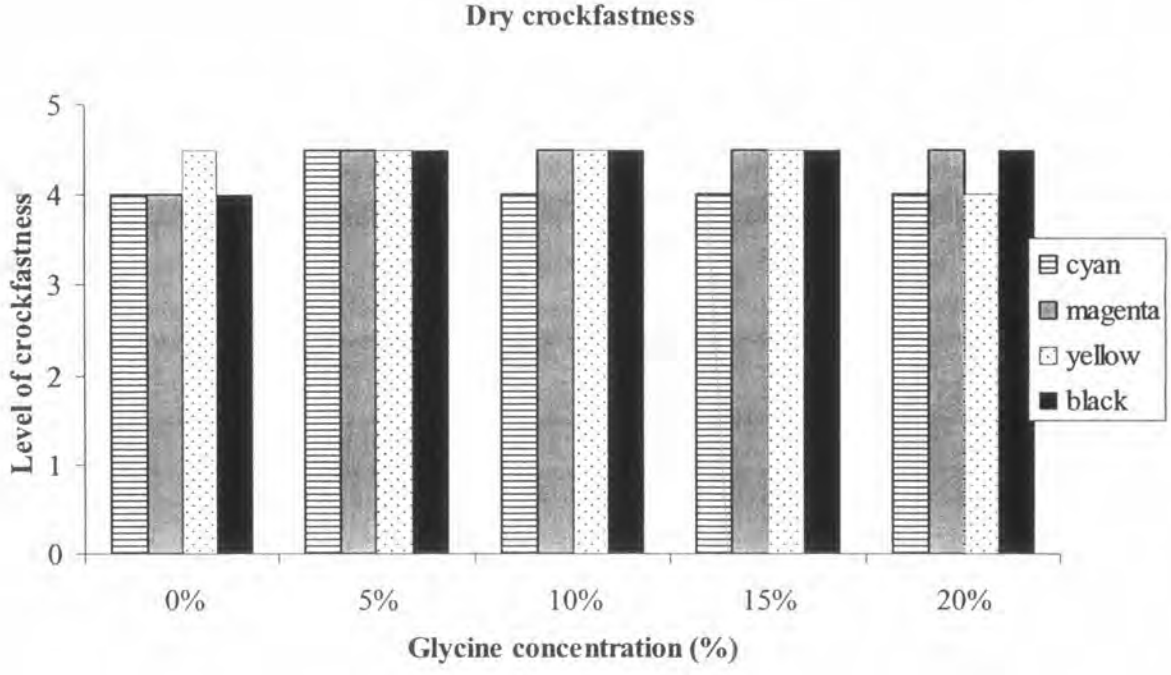


Figure E5: Dry crockfastness of the non-treated silk and silk coated with glycine at various concentrations

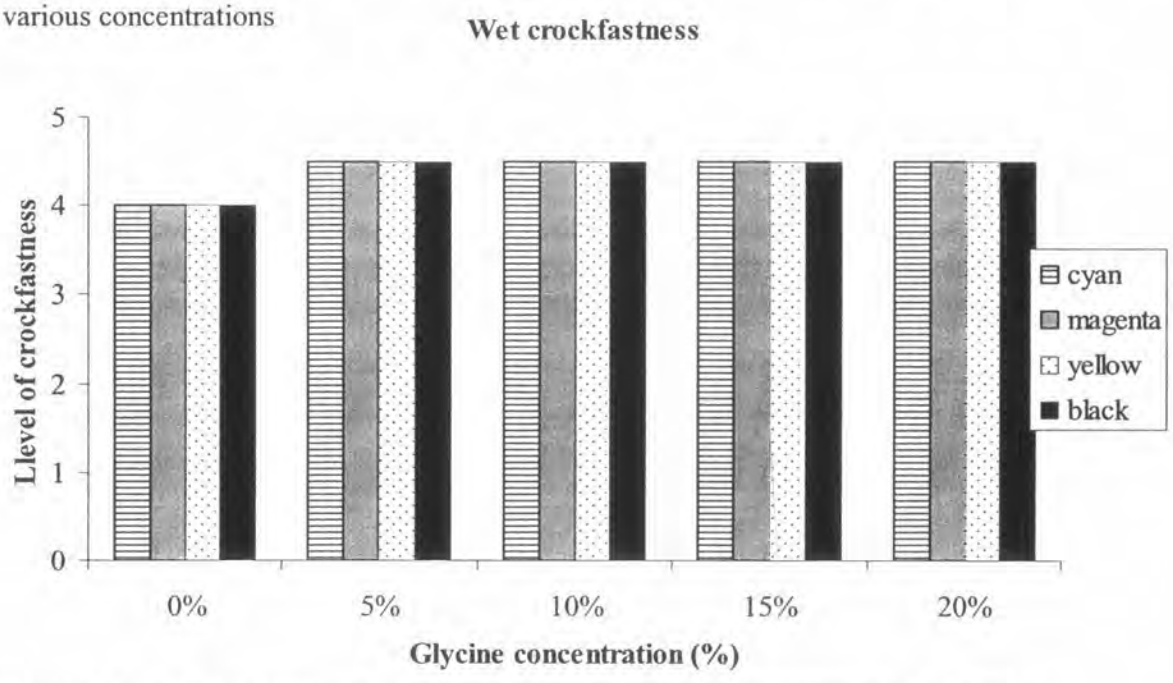


Figure E6: Wet crockfastness of the non-treated silk and silk coated with glycine at various concentrations

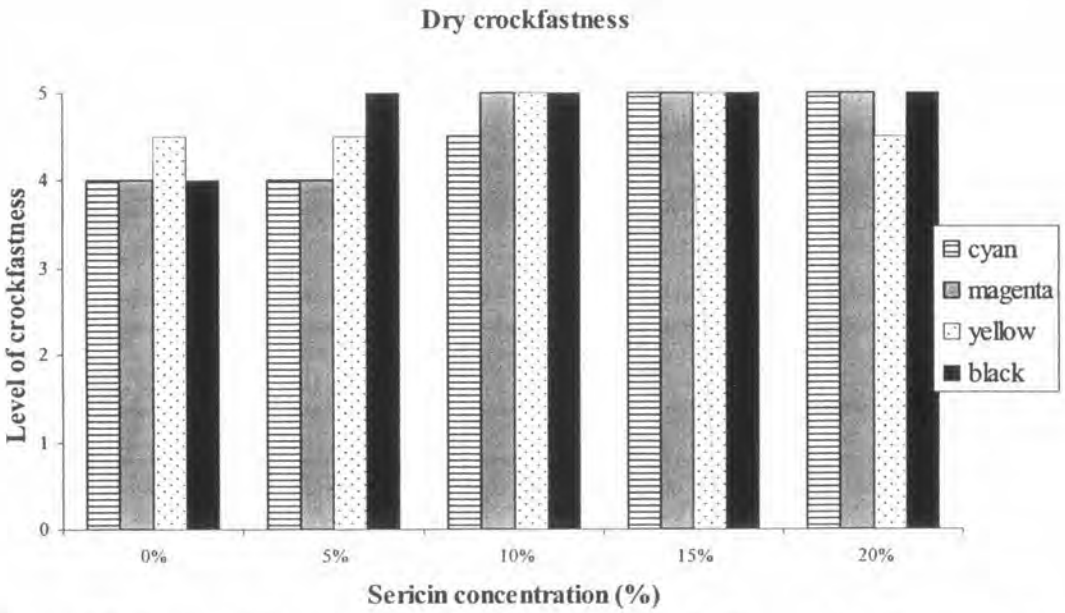


Figure E7: Dry crockfastness of the non-treated silk and silk coated with sericin at various concentrations

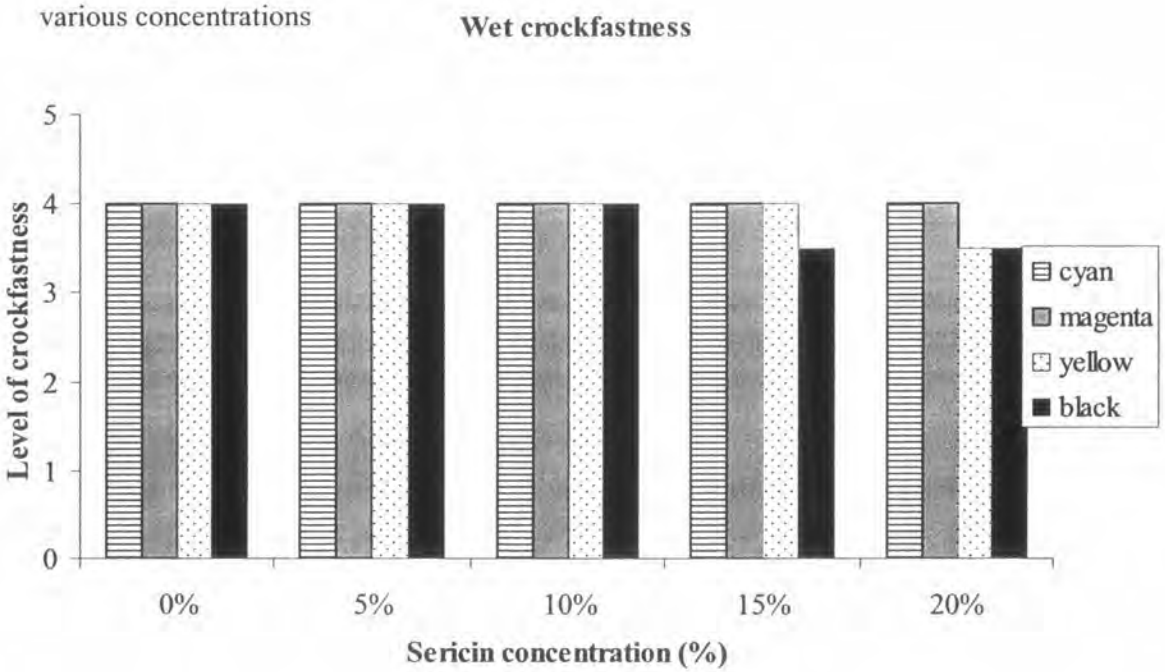


Figure E8: Wet crockfastness of the non-treated silk and silk coated with sericin at various concentrations

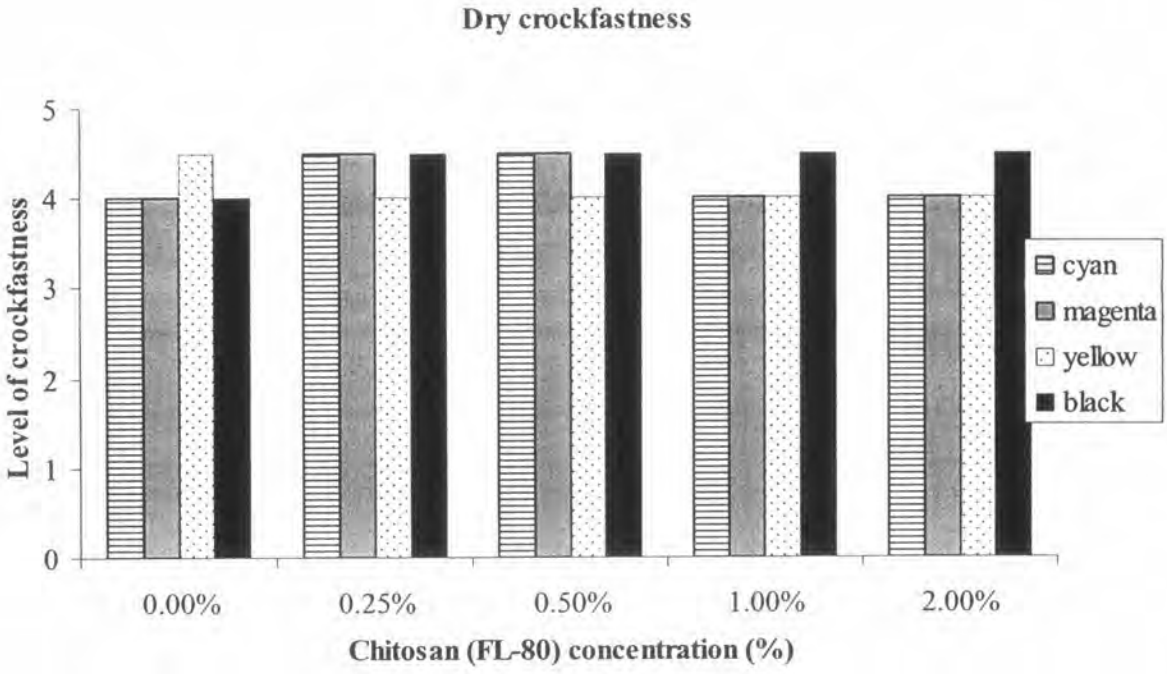


Figure E9: Dry crockfastness of the non-treated silk and silk coated with chitosan (MW = 1.2 x 10^5) at various concentrations

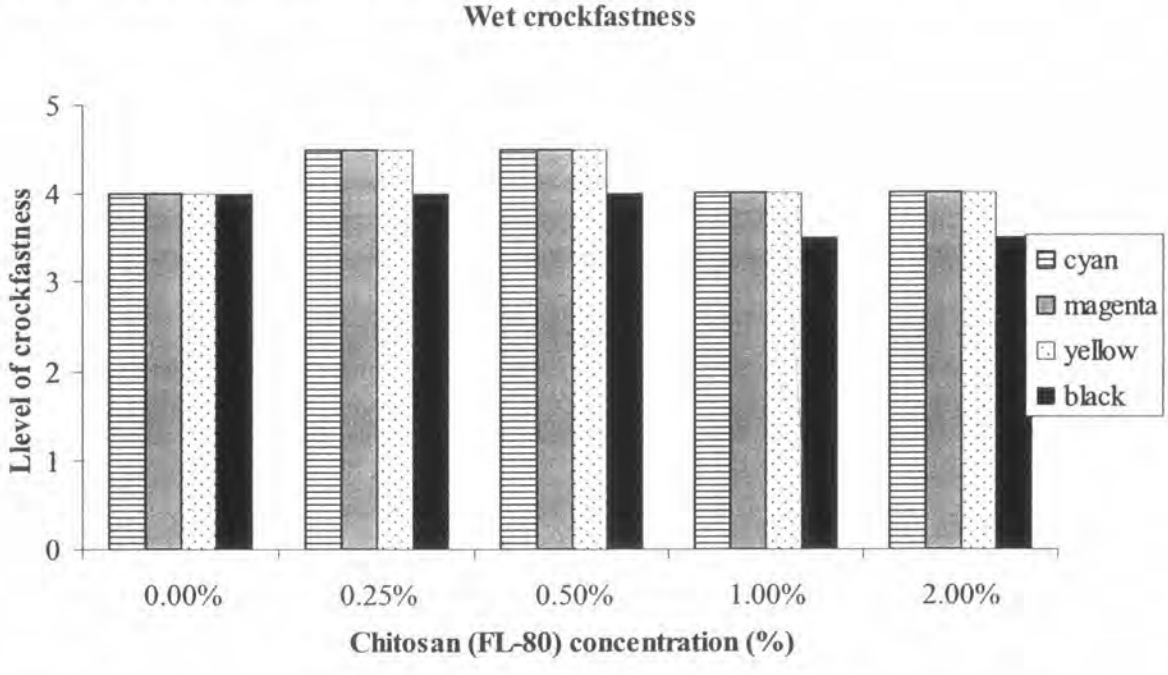


Figure E10: Wet crockfastness of the non-treated silk and silk coated with chitosan (MW = 1.2 x 10^5) at various concentrations

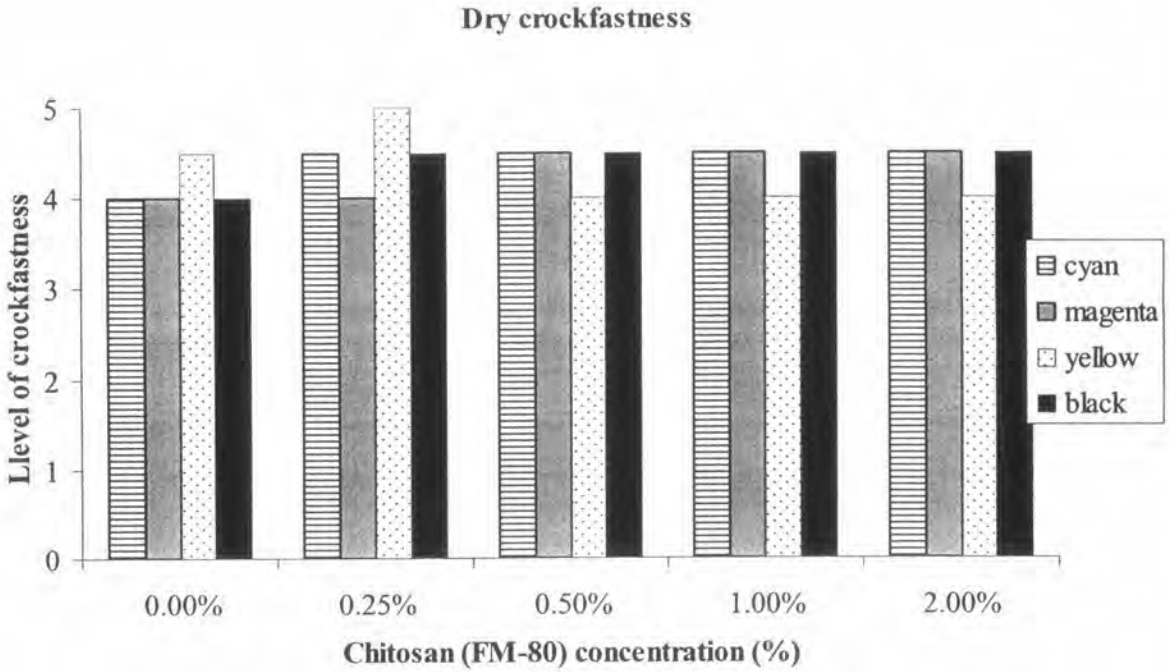


Figure E11: Dry crockfastness of the non-treated silk and silk coated with chitosan (MW = 3.7 x 10^5) at various concentrations

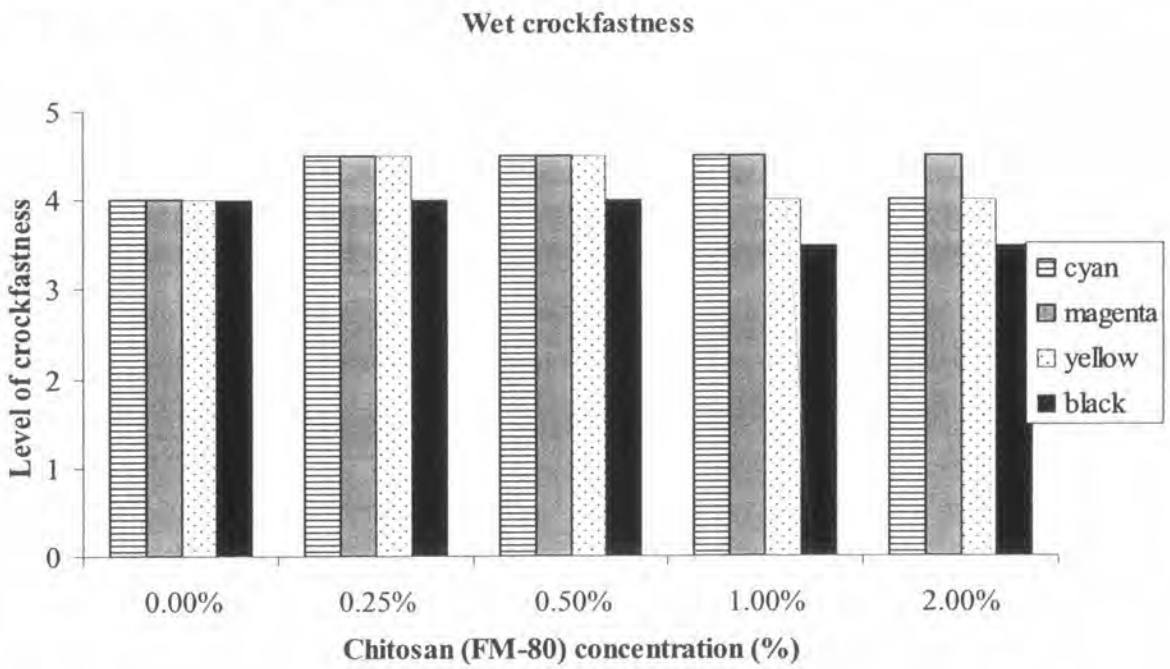


Figure E12: Wet crockfastness of the non-treated silk and silk coated with chitosan (MW = 3.7 x 10^5) at various concentrations

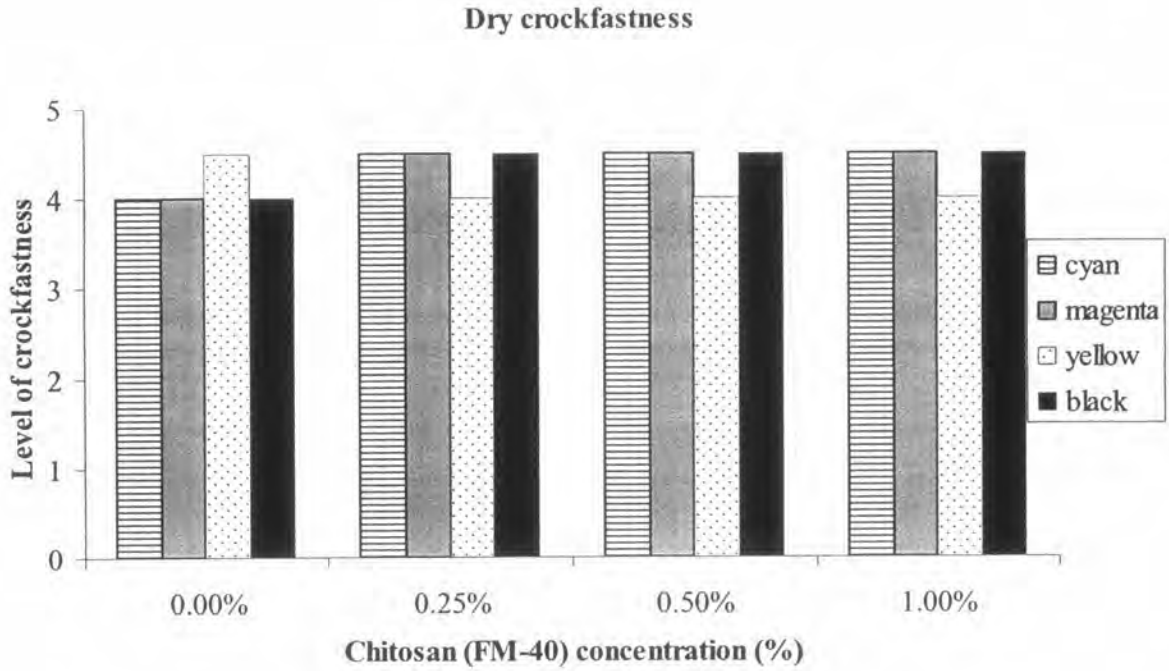


Figure E13: Dry crockfastness of the non-treated silk and silk coated with chitosan (MW = 8.5 x 10^5) at various concentrations

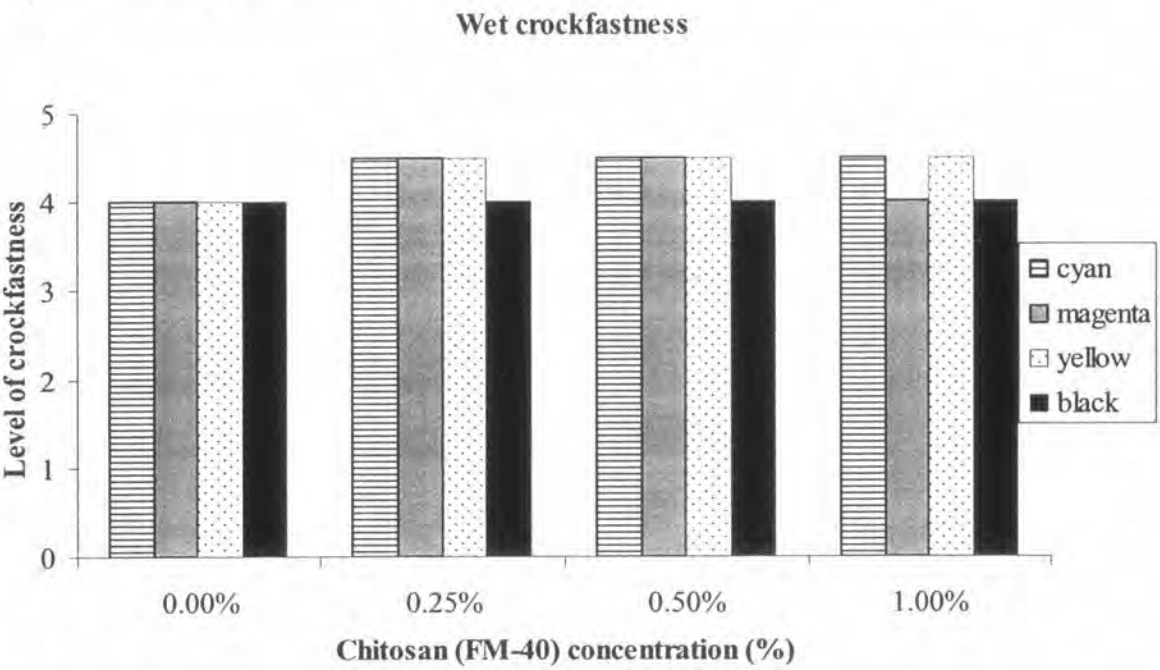


Figure E14: Wet crockfastness of the non-treated silk and silk coated with chitosan (MW = 8.5 x 10^5) at various concentrations

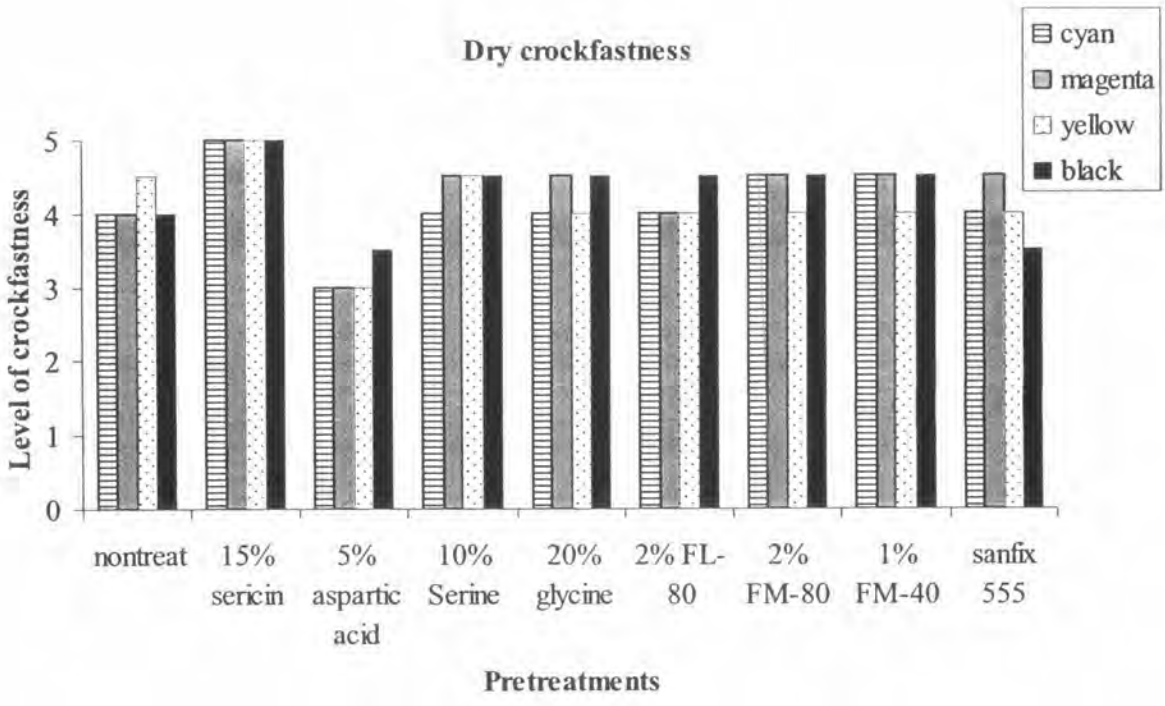


Figure E15: Dry crockfastness of the non-treated silk and silk coated with the pretreatments

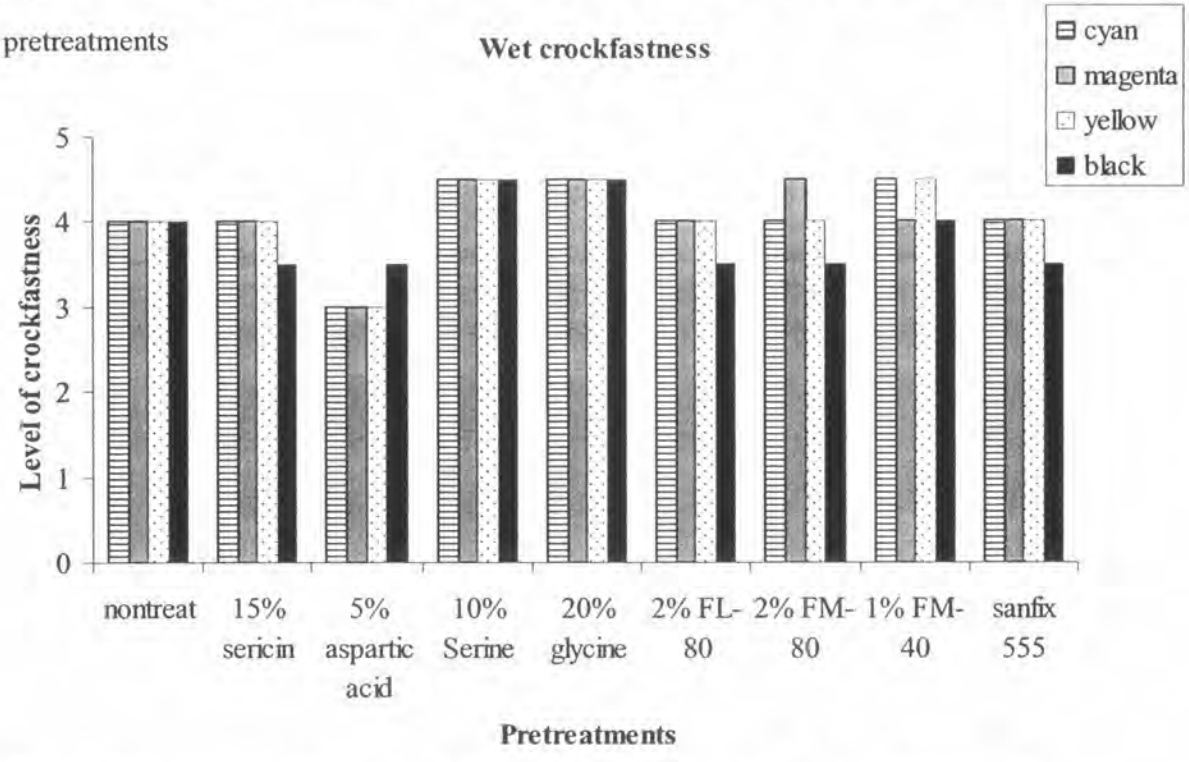


Figure E16: Wet crockfastness of the non-treated silk and silk coated with the pretreatments

APPENDIX F

STIFFNESS OF THE PRINTED FABRICS

Table F1: Bending length (C) of the printed fabrics with various pretreatments in the warp direction

	Bending length (cm)							
	Warp							
	C		M		Y		K	
Pretreatments	**X**	**SD**	**X**	**SD**	**X**	**SD**	**X**	**SD**
Non-treated	2.06	0.05	2.12	0.04	2.24	0.12	2.20	0.14
20% Glycine	2.83	0.35	3.14	0.40	2.24	0.11	2.94	0.24
15% Sericin	3.45	0.11	3.91	0.10	3.67	0.09	3.64	0.10
2% Chitosan	4.51	0.37	4.57	0.32	4.90	0.29	5.25	0.31
10% Sanfix 555	3.31	0.17	3.12	0.24	3.04	0.16	3.39	0.10
	X				**SD**			
Non-printed	2.29				0.09			

Table F2: Bending length (C) of the printed fabrics with various pretreatments in the weft direction

	Bending length (cm)							
	Weft							
	C		M		Y		K	
Pretreatments	**X**	**SD**	**X**	**SD**	**X**	**SD**	**X**	**SD**
Non-treated	2.06	0.05	2.12	0.04	2.24	0.12	2.20	0.14
20% Glycine	2.83	0.35	3.14	0.40	2.24	0.11	2.94	0.24
15% Sericin	3.45	0.11	3.91	0.10	3.67	0.09	3.64	0.10
2% Chitosan	4.51	0.37	4.57	0.32	4.90	0.29	5.25	0.31
10% Sanfix 555	3.31	0.17	3.12	0.24	3.04	0.16	3.39	0.10
	X				**SD**			
Non-printed	2.29				0.09			

Table F3: Mass per unit area (W) of the printed fabrics with various pretreatments in the warp direction

	Mass per unit area (mg/cm^2)							
	Warp							
	C		M		Y		K	
Pretreatments	**X**	**SD**	**X**	**SD**	**X**	**SD**	**X**	**SD**
Non-treated	11.56	0.91	13.96	0.7	12.89	1.03	11.47	0.83
20% Glycine	12.51	0.67	12.89	0.48	12.13	0.64	11.42	0.4
15% Sericin	11.69	0.75	11.43	0.67	13.25	0.88	12.67	0.46
2% Chitosan	11.1	0.72	11	0.62	11.37	0.48	10.79	0.43
10% Sanfix 555	14.08	0.48	15.44	0.74	14.32	0.9	14.74	0.42
	X				**SD**			
Non-printed	12.09				0.29			

Table F4: Mass per unit area (W) of the printed fabrics with various pretreatments in the weft direction

	Mass per unit area (mg/cm^2)							
	Weft							
	C		M		Y		K	
Pretreatments	**X**	**SD**	**X**	**SD**	**X**	**SD**	**X**	**SD**
Non-treated	11.77	0.27	13.4	0.81	13.08	0.38	10.68	0.55
20% Glycine	11.37	0.43	11.82	0.82	11.43	0.02	11.19	0.97
15% Sericin	11.44	0.63	11.06	1.01	12.04	1.86	13.1	1.92
2% Chitosan	11.13	0.7	11.09	1.07	11.1	0.91	11.86	0.6
10% Sanfix 555	13.33	1.27	14.62	1.44	14.68	1.08	14.47	0.79
	X				**SD**			
Non-printed	12.21				0.47			

Table F5: Stiffness (G) of the printed fabrics with various pretreatments in the warp direction ($G = W \times C^3$)

	Stiffness (mg cm)							
	Warp							
	C		M		Y		K	
Pretreatments	**X**	**SD**	**X**	**SD**	**X**	**SD**	**X**	**SD**
Non-treated	101.50	0.00	133.58	0.00	145.46	0.00	121.30	0.00
20% Glycine	282.94	0.03	399.06	0.03	136.88	0.00	288.73	0.01
15% Sericin	477.95	0.00	682.20	0.00	654.96	0.00	610.05	0.00
2% Chitosan	1014.86	0.04	1046.44	0.02	1337.67	0.01	1556.89	0.01
10% Sanfix 555	512.00	0.00	466.68	0.01	403.50	0.00	573.23	0.00
	X				SD			
Non-printed	144.81				0.00			

Table F6: Stiffness (G) of the printed fabrics with various pretreatments in the weft direction ($G = W \times C^3$)

	Stiffness (mg cm)							
	weft							
	C		M		Y		K	
Pretreatments	**X**	**SD**	**X**	**SD**	**X**	**SD**	**X**	**SD**
Non-treated	101.50	0.00	133.58	0.00	145.46	0.00	121.30	0.00
20% Glycine	282.94	0.03	399.06	0.03	136.88	0.00	288.73	0.01
15% Sericin	477.95	0.00	682.20	0.00	654.96	0.00	610.05	0.00
2% Chitosan	1014.86	0.04	1046.44	0.02	1337.67	0.01	1556.89	0.01
10% Sanfix 555	512.00	0.00	466.68	0.01	403.50	0.00	573.23	0.00
	X				SD			
Non-printed	144.81				0.00			

X: average

SD: Standard derivation

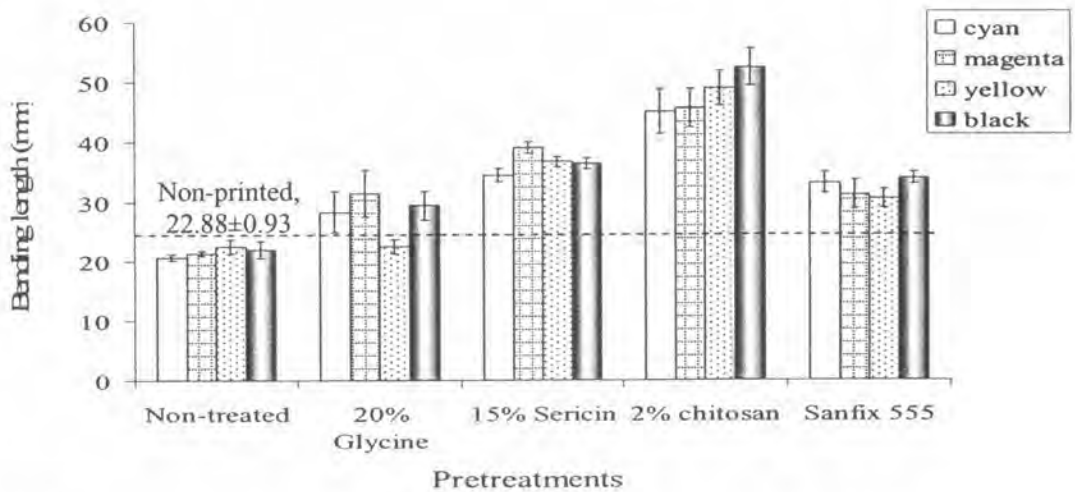


Figure F7: Stiffness of the non-treated and pretreated silk fabrics in the warp direction

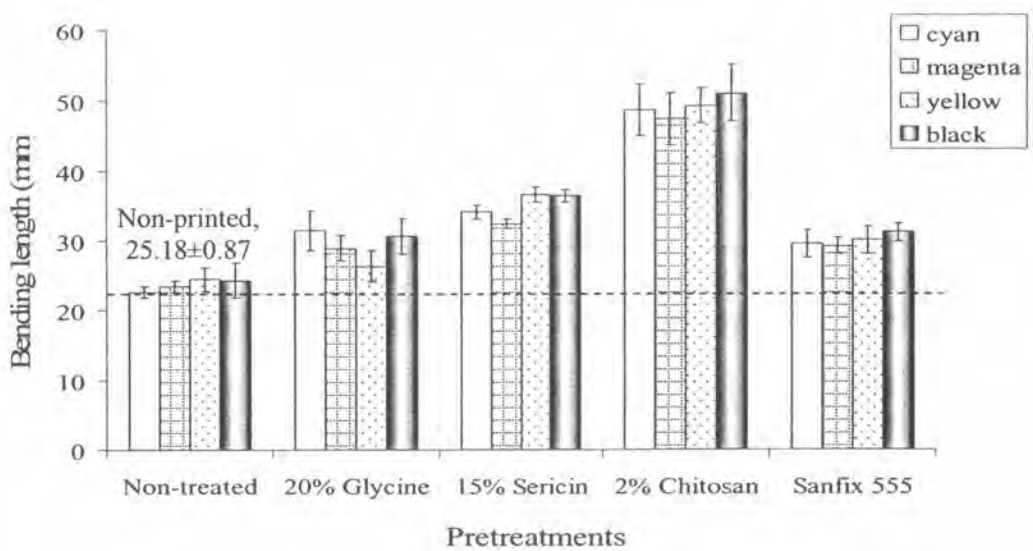


Figure F8: Stiffness of the non-treated and pretreated silk fabrics in the weft direction

APPENDIX G

FT-IR SPECTRA OF THE PIGMENT DISPERSIONS

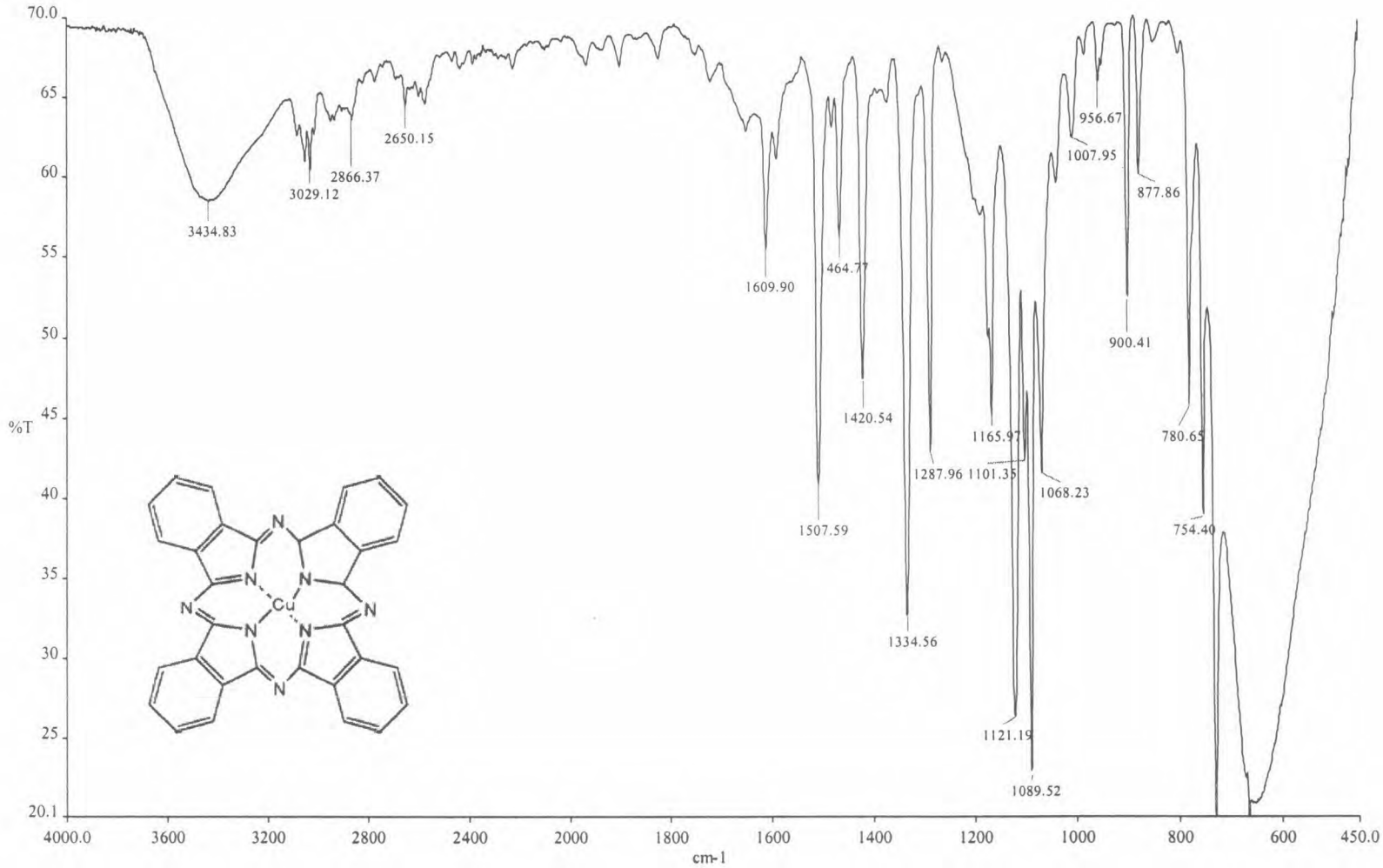


Figure G1: Infrared spectrum of the cyan pigment dispersion (C.I. Pigment Blue 15:4)

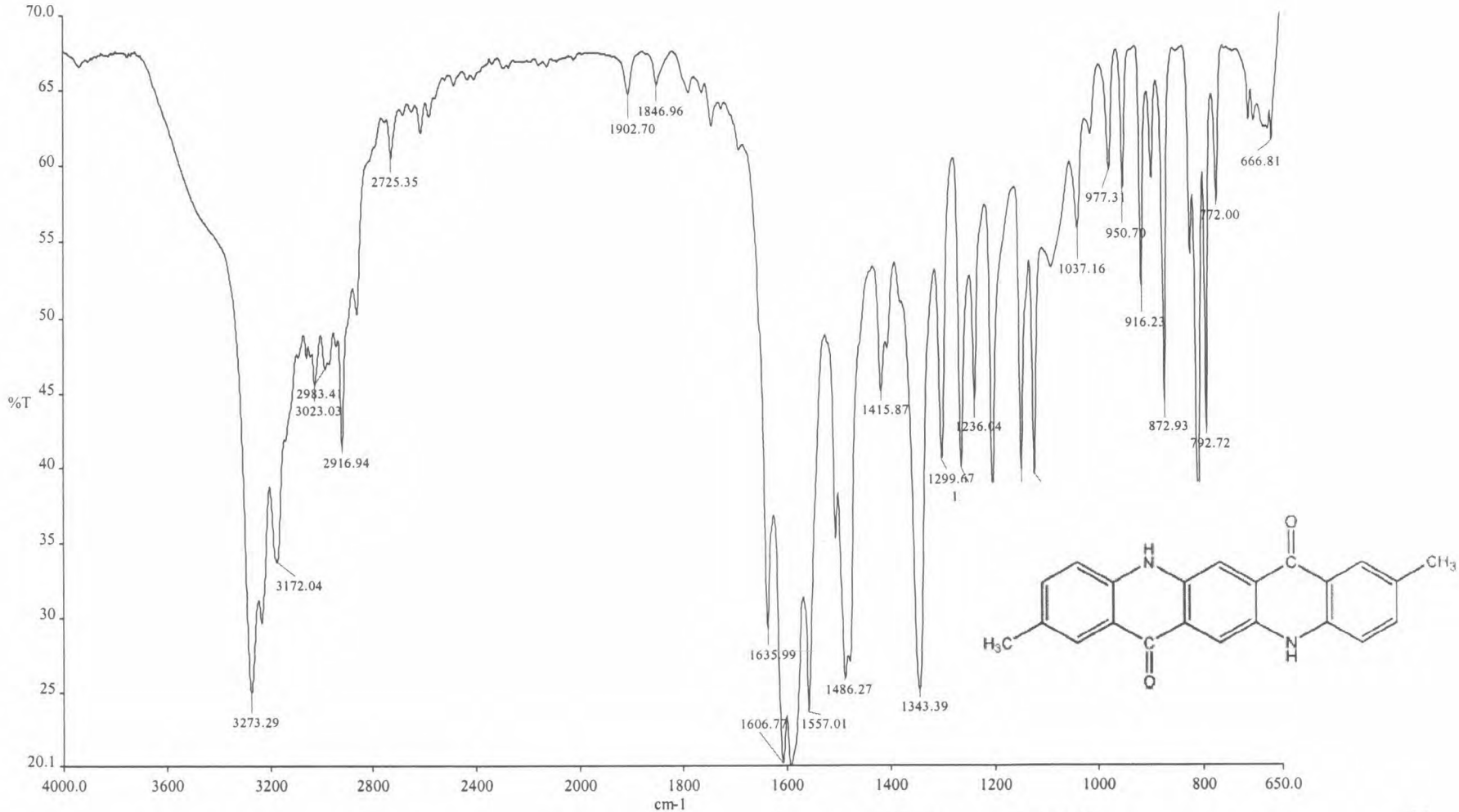


Figure G2: Infrared spectrum of the magenta pigment dispersion (C.I. Pigment Red 122)

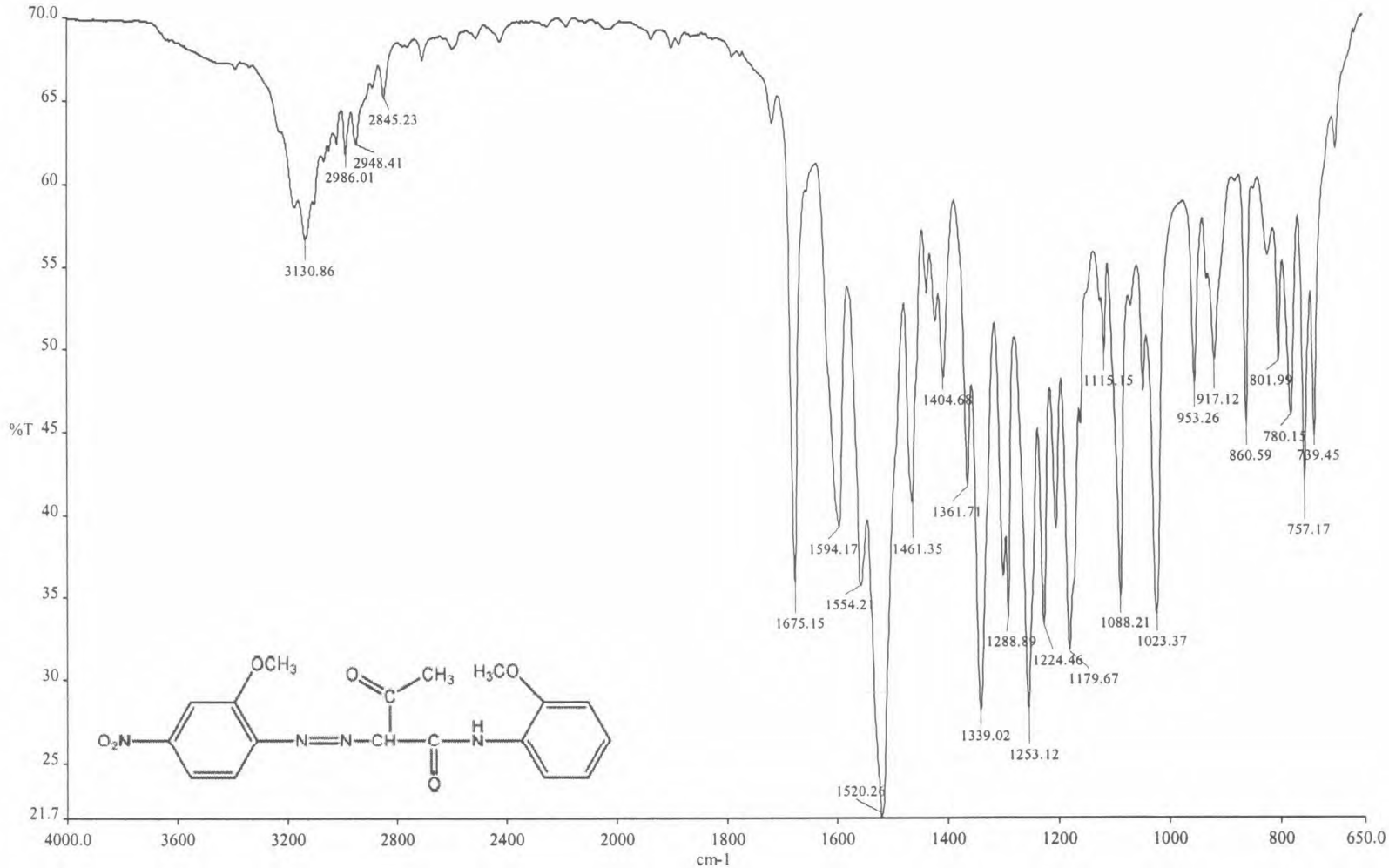


Figure G3: Infrared spectrum of the yellow pigment dispersion (C.I. Pigment Yellow 74)

APPENDIX H

FTIR - ATR SPECTRA OF THE PRETREATED SILK FABRICS

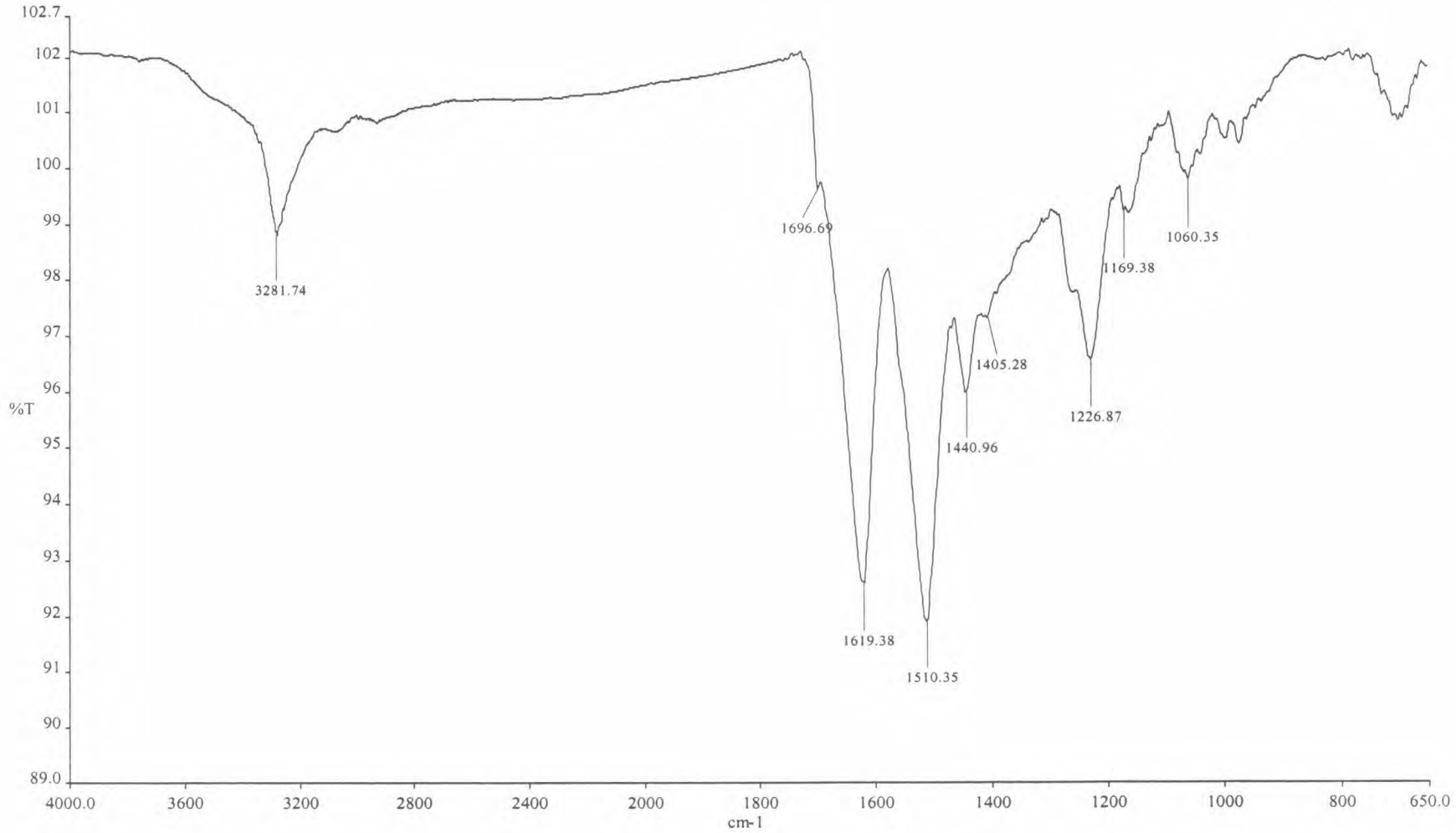


Figure H1: FTIR-ATR Spectrum of the non-treated silk surface

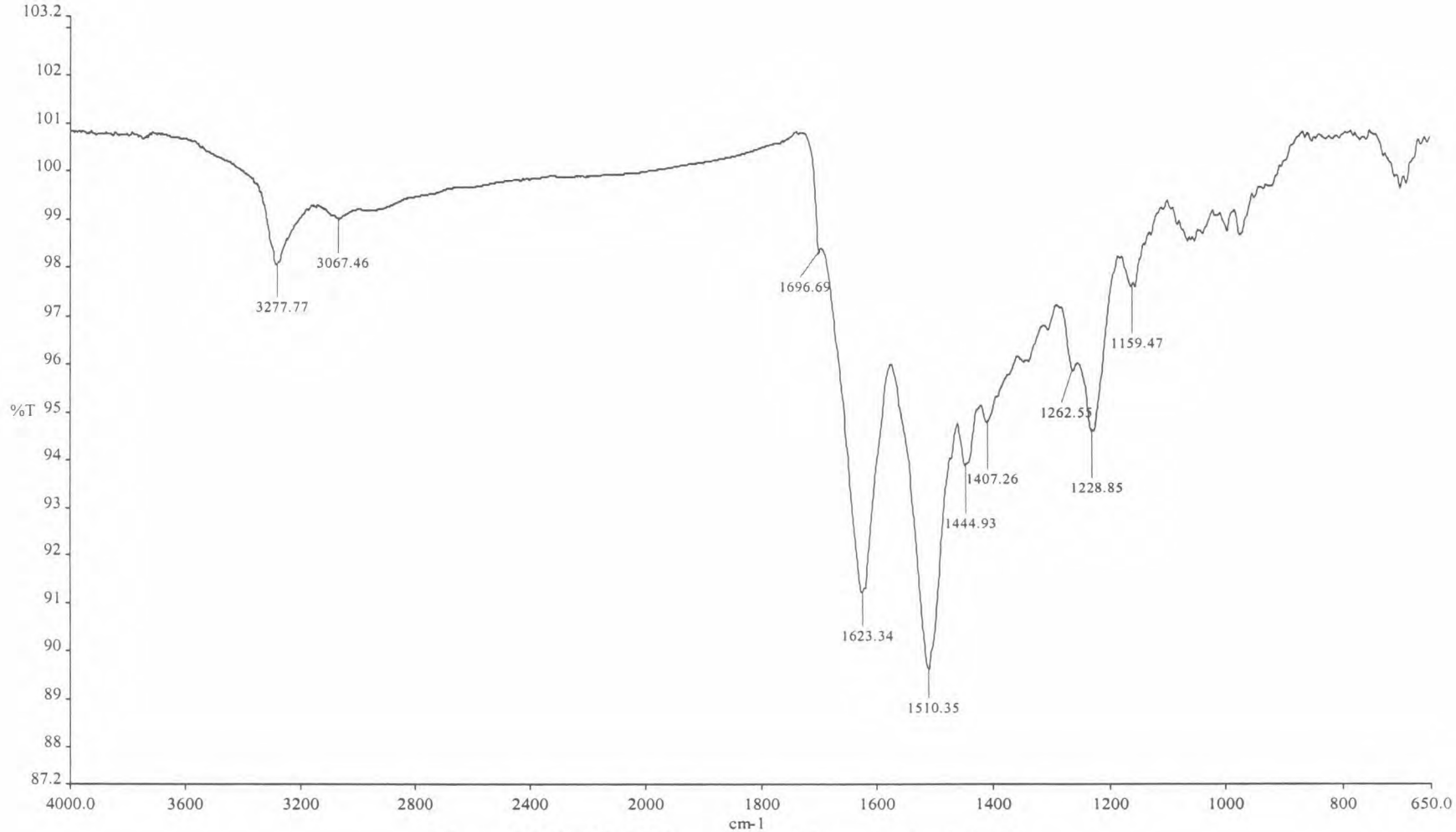


Figure H2: FTIR-ATR spectrum of the serine treated silk

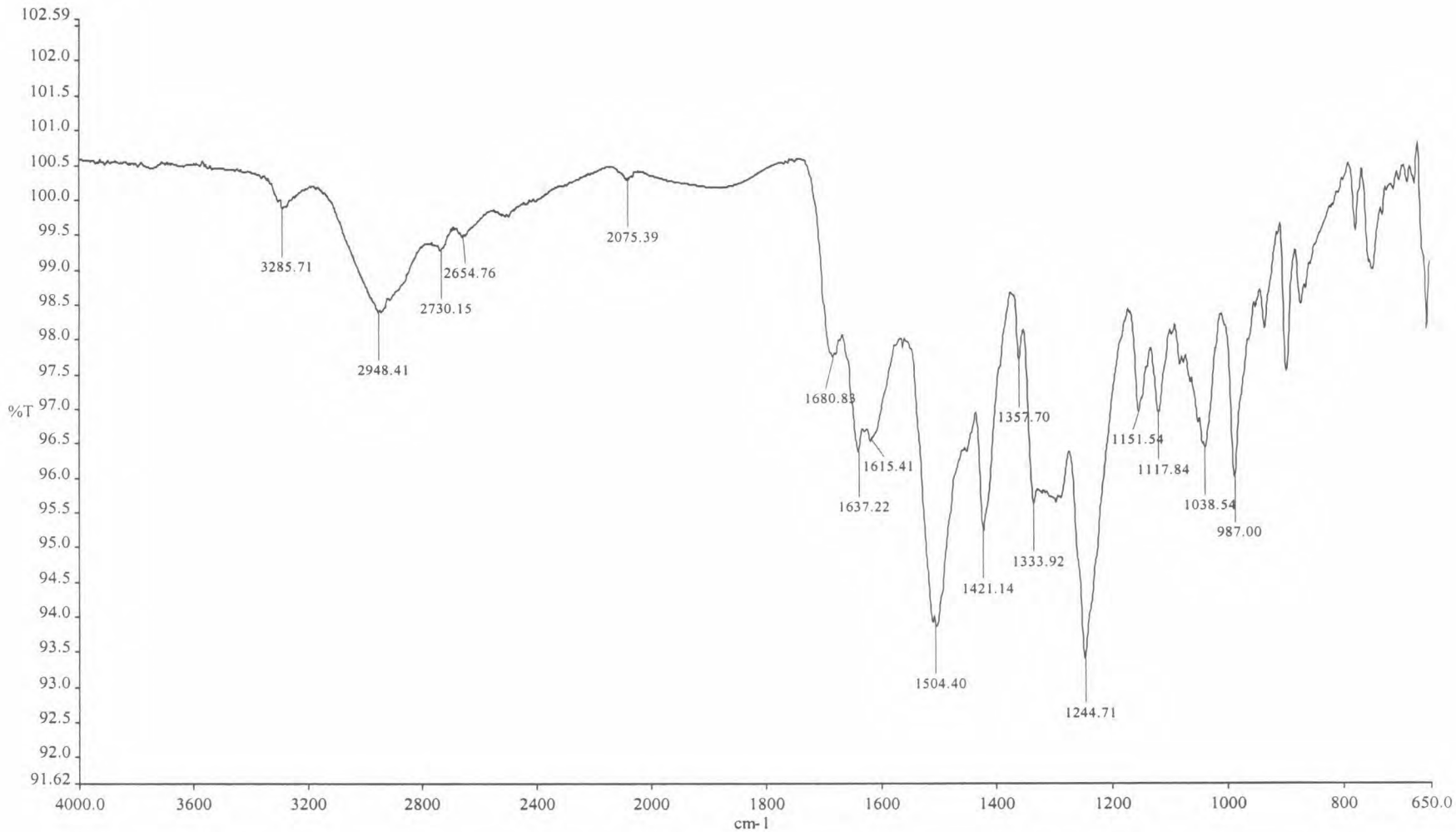


Figure H3: FTIR-ATR spectrum of the aspartic acid treated silk

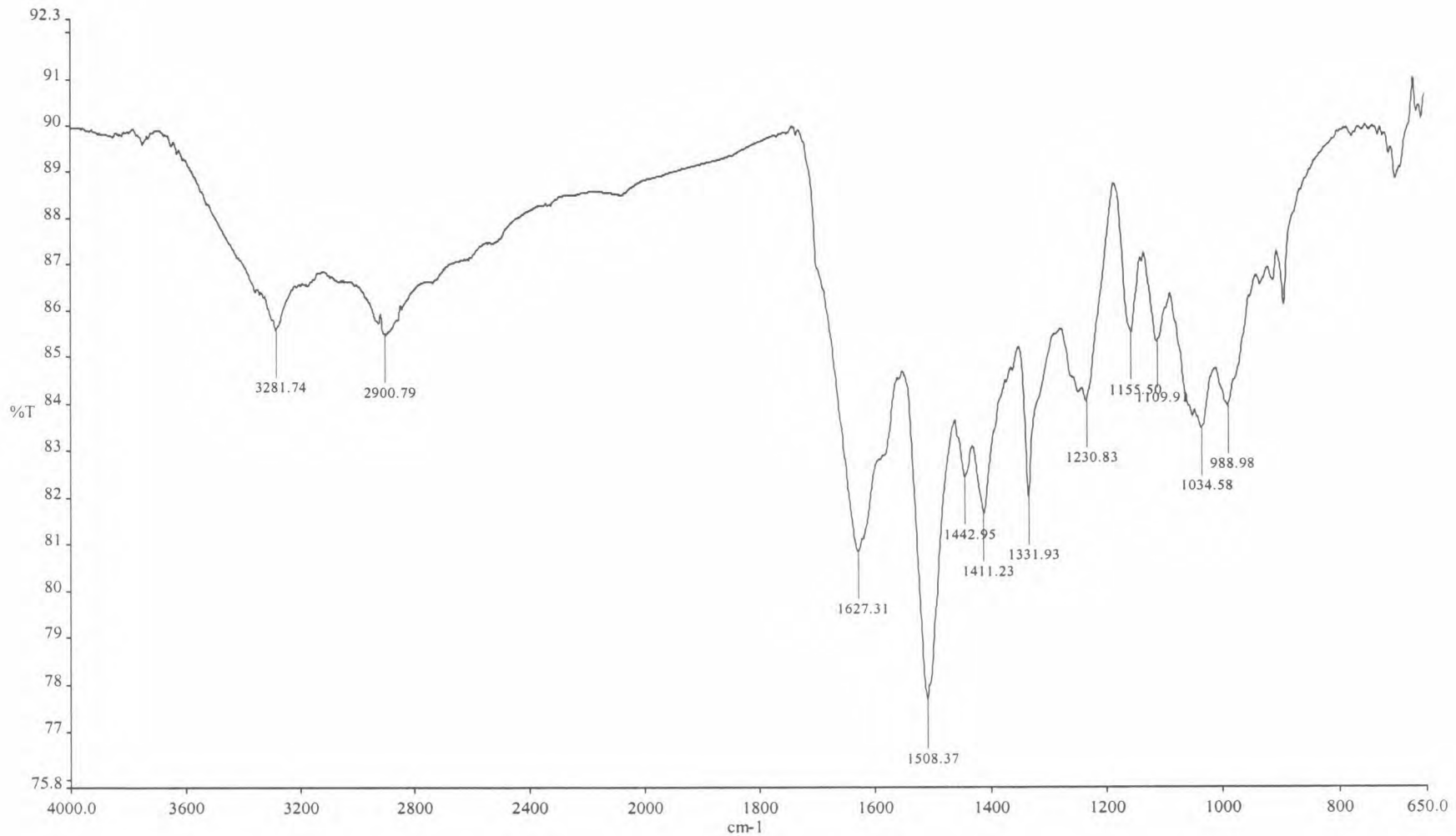


Figure H4: FTIR-ATR spectrum of the glycine treated silk

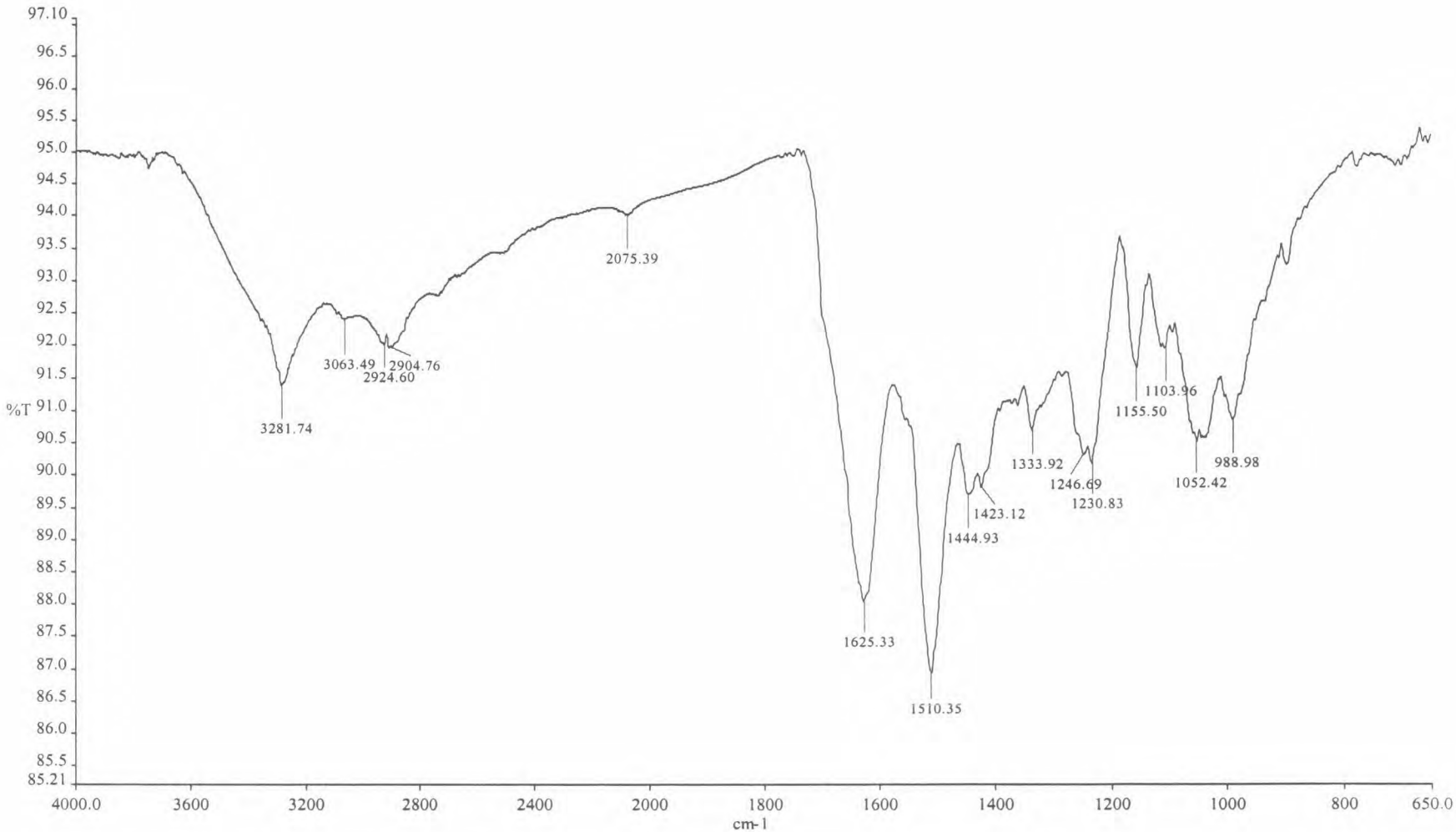


Figure H5: FTIR-ATR spectrum of the sericin treated silk

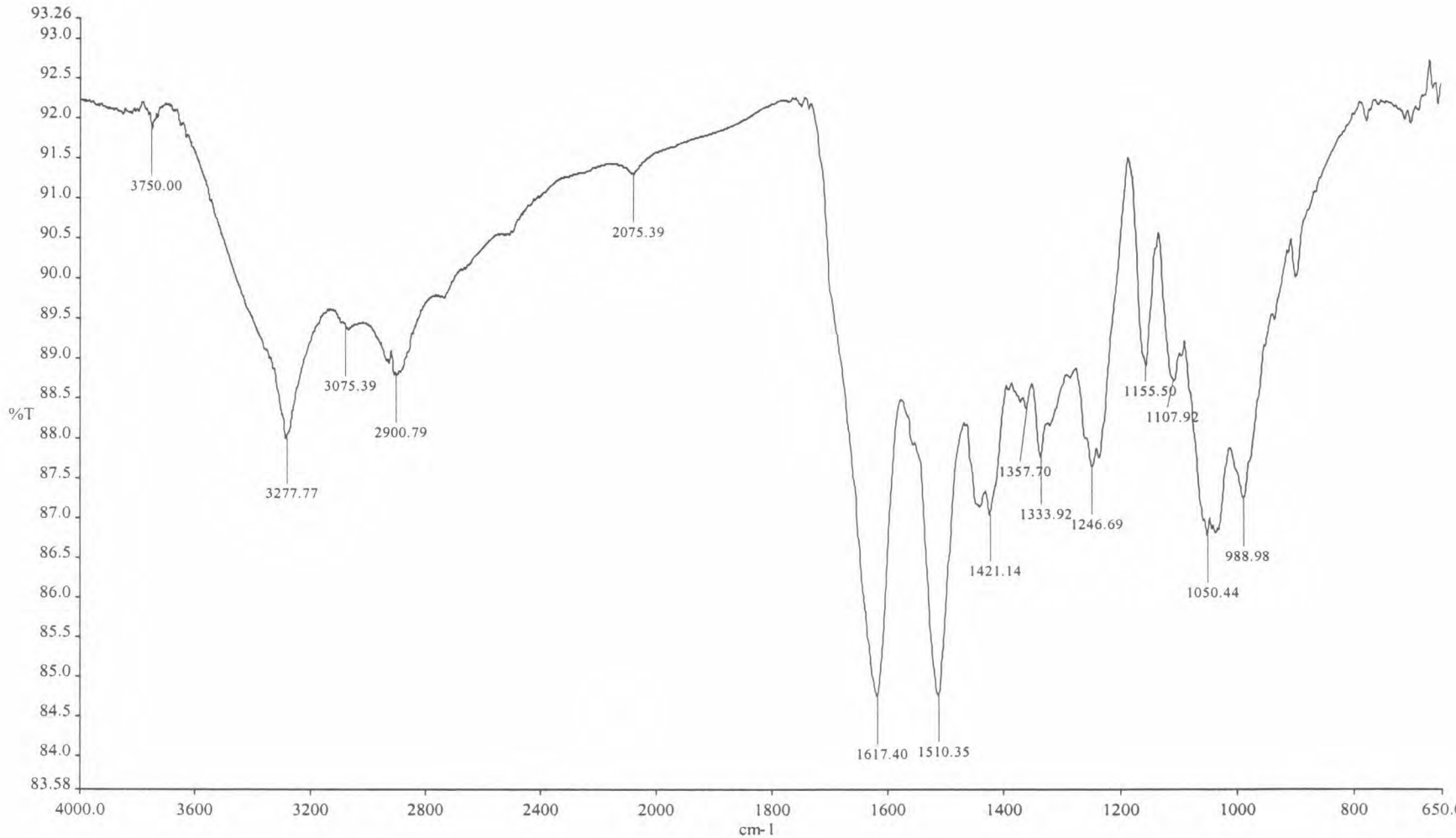


Figure H6: FTIR-ATR spectrum of the chitosan treated silk

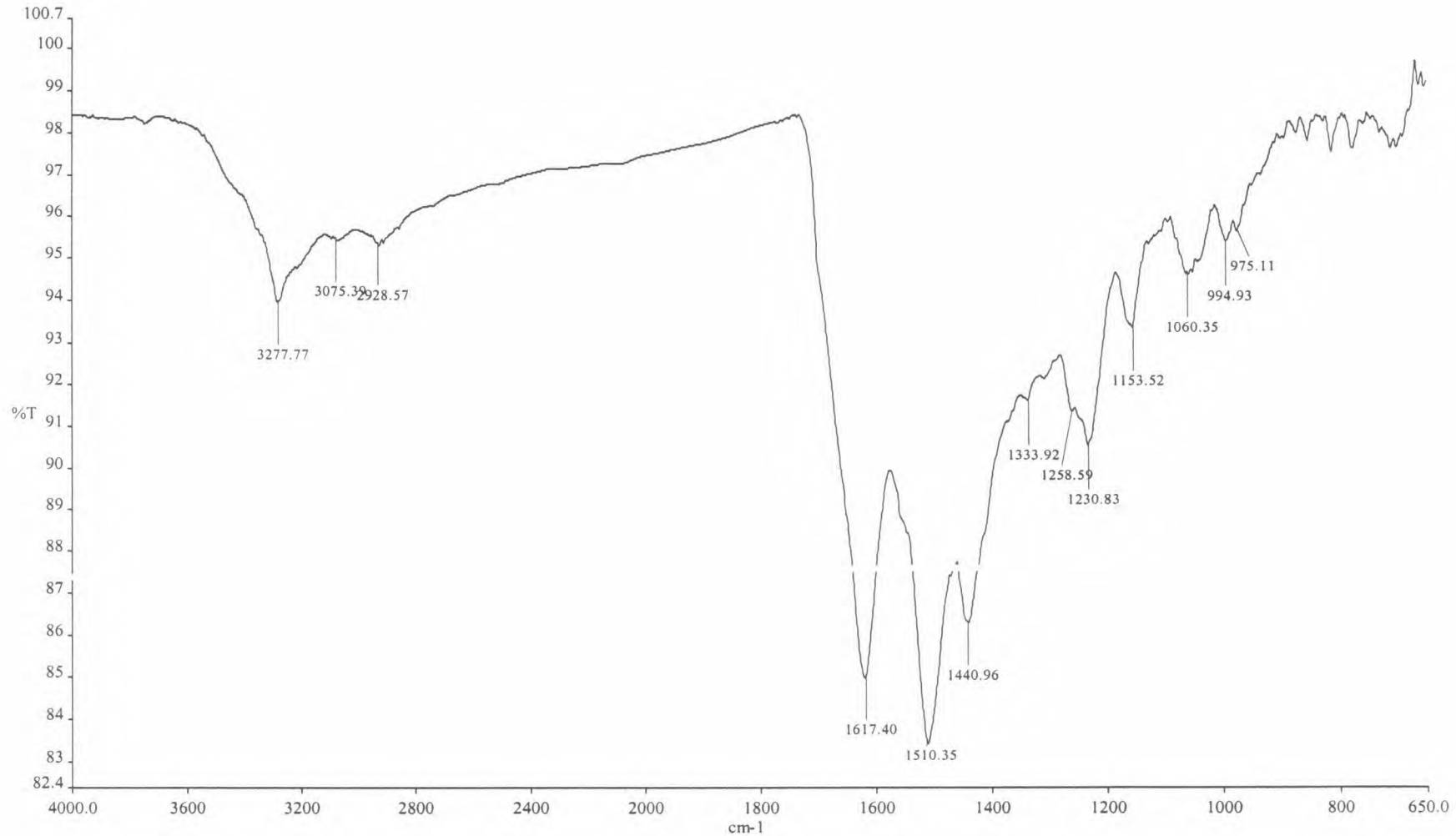


Figure H7: FTIR-ATR spectrum of the sanfix 555 treated silk

APPENDIX I

RAMAN SPECTROSCOPIC SPECTRA OF THE PRE-TREATING MATERIALS AND THE INKS

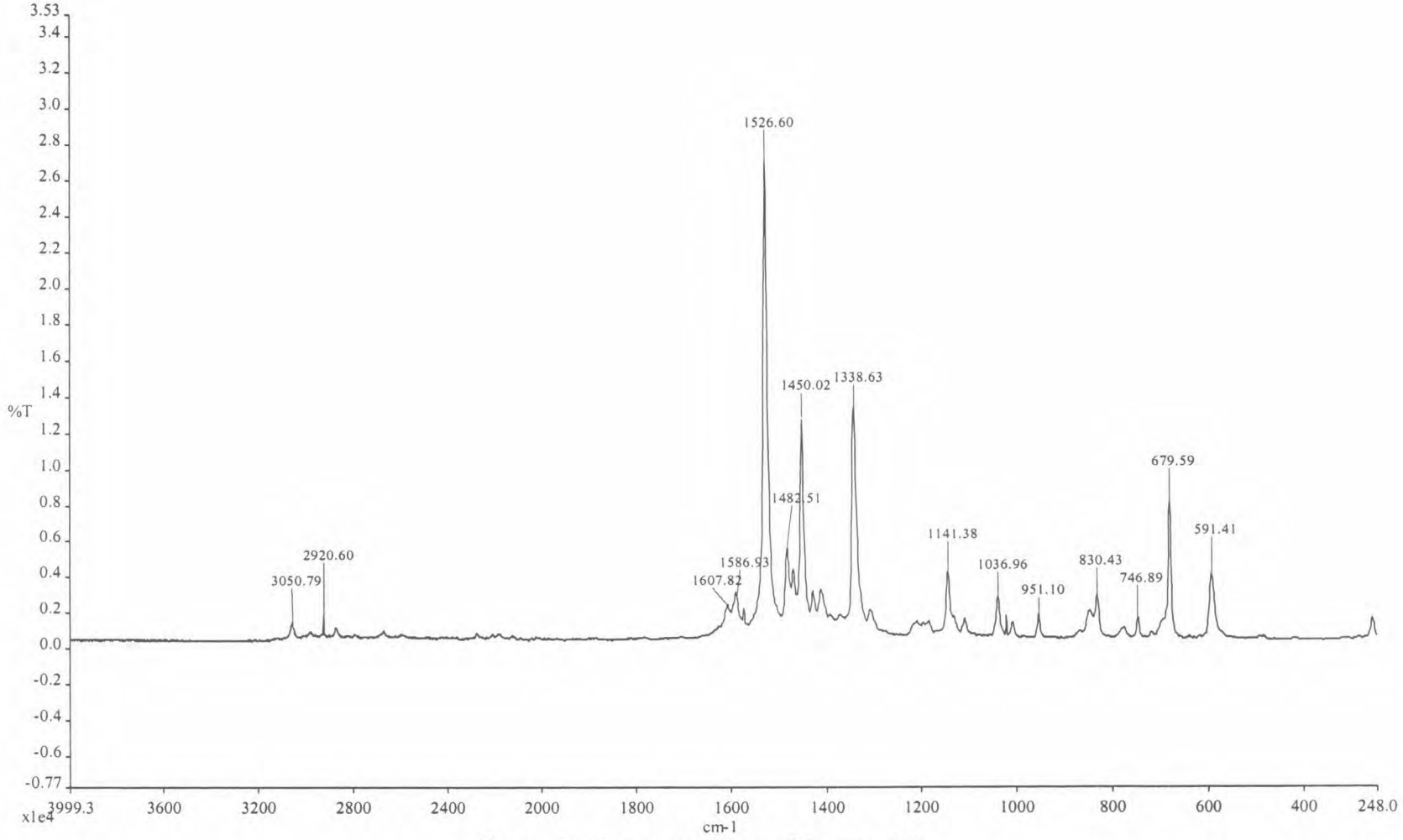


Figure I1: Raman spectrum of the cyan ink

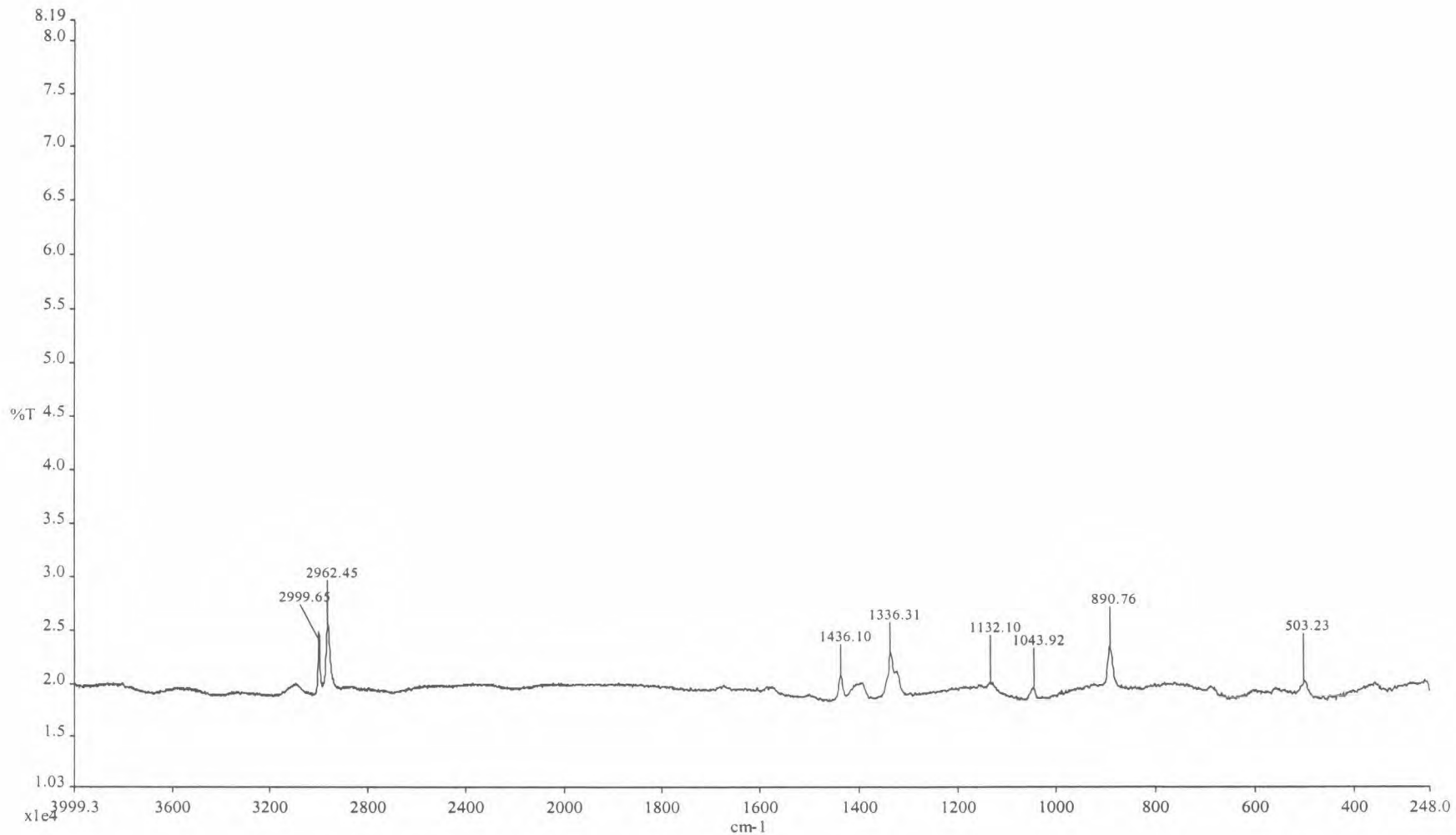


Figure I2: Raman spectrum of glycine

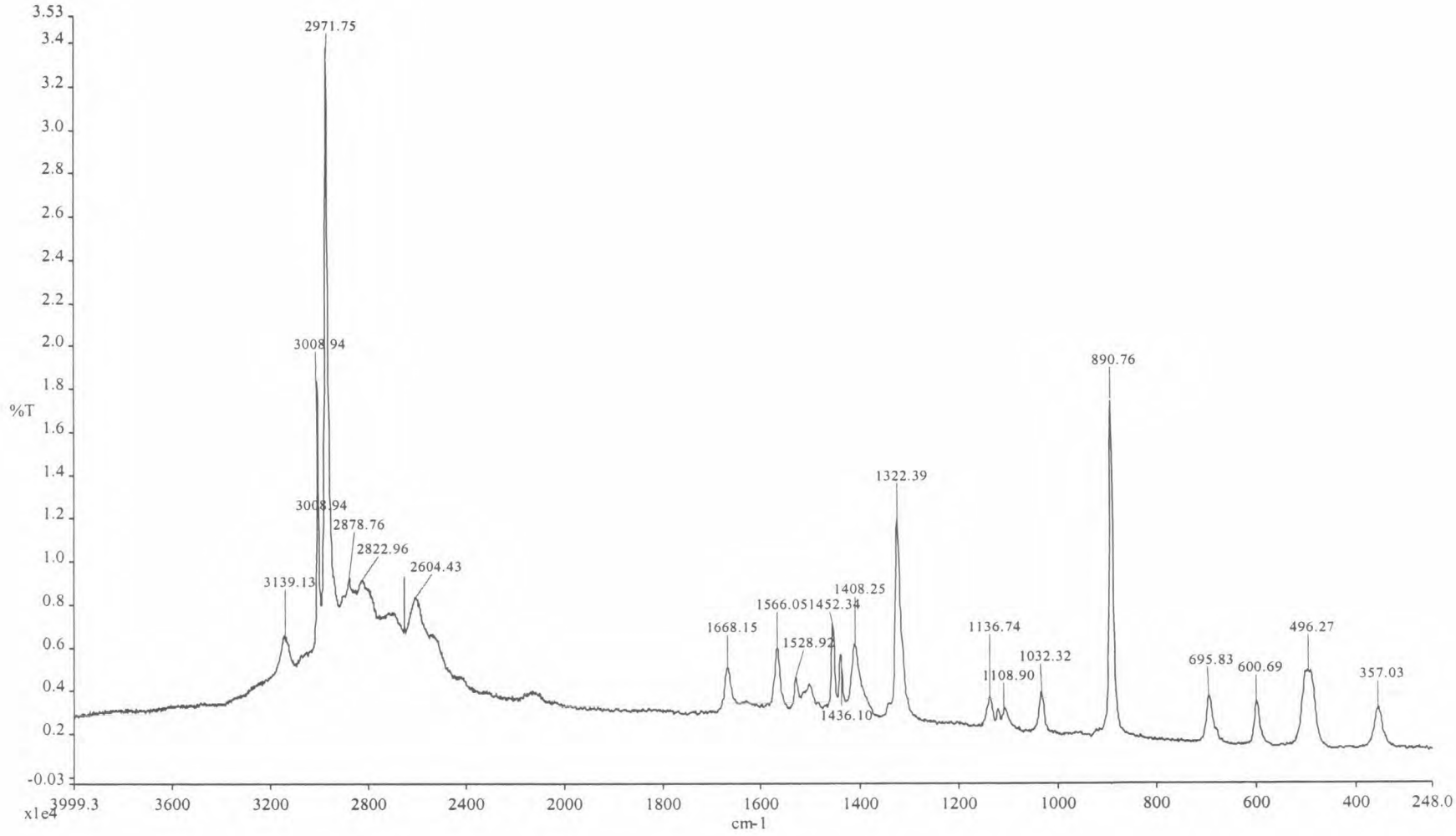


Figure I3: Raman spectrum of glycine and the cyan ink

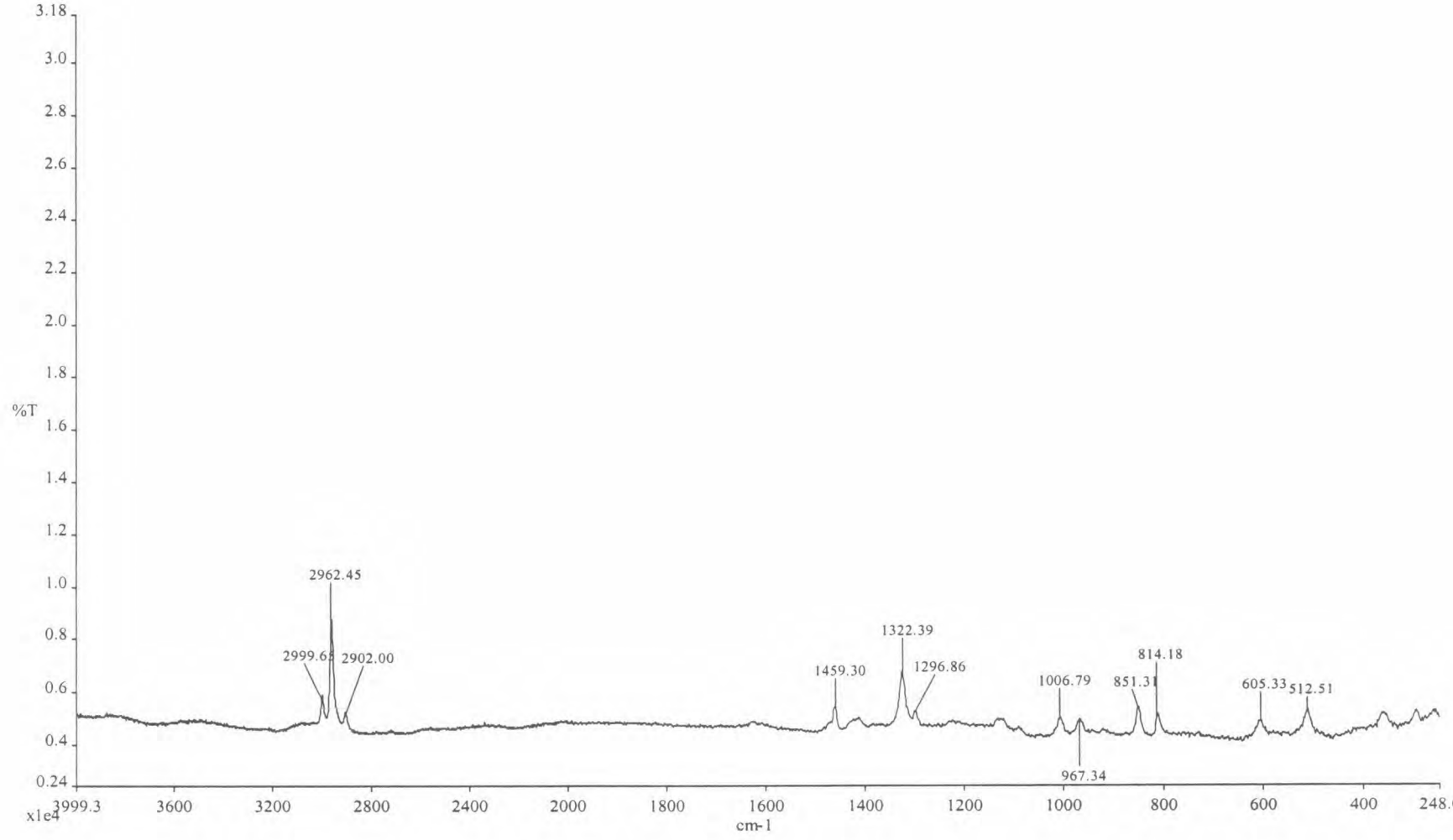


Figure I4: Raman spectrum of serine

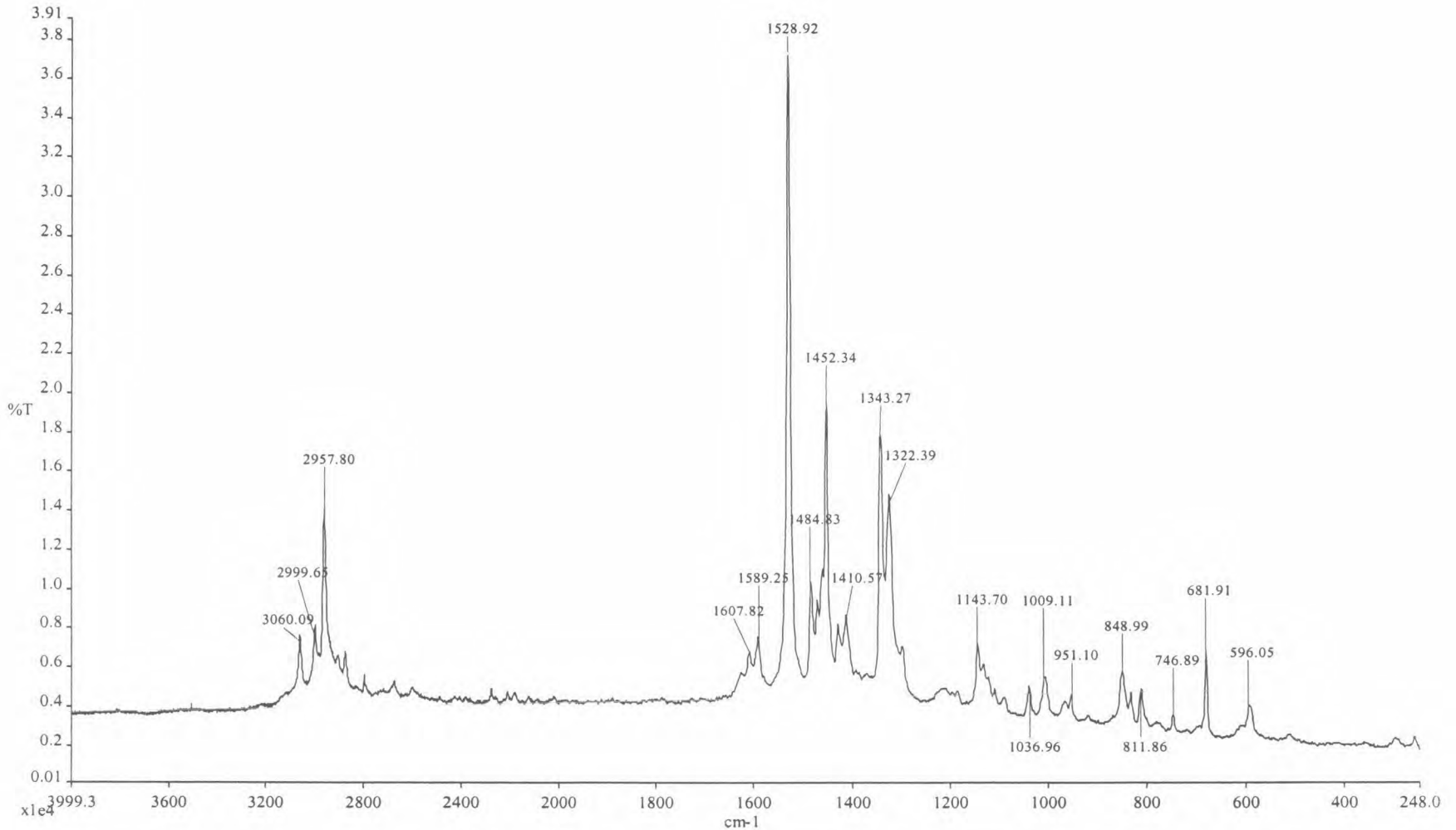


Figure I5: Raman spectrum of serine and the cyan ink

VITA

Miss Klongthong Chakvattanatham was born on June 15, 1981 in Bangkok, Thailand. She graduated with a Bachelor's Degree in Industrial Chemistry from the Faculty of Science, King Mongkut's Institute of Technology Ladkrabang on March 31, 2004. She has been a graduate student in the Program of Imaging Technology, Faculty of Science, Chulalongkorn University since June 2004 and finished her Master's degree in Science in May 2007.