CHAPTER IV

RESULTS AND DISCUSSION

4.1 Appropriate conditions for dye extraction

4.1.1 Appropriate temperature for dye extraction

Table 4.1 Percentage of total solid from dye extraction by varying temperature of extraction

Eucalyptus leaves					
Temperature (°C)	Time (Hour)	Liqour ratio	% Total Solid		
			Distilled water	Methanol	Ethanol
50	3	1:40	21.0	19.7	11.9
60	3	1:40	23.3	23.4	20.2
70	3	1:40	24.6	23.5	22.5
80	3	1:40	27.2	26.9	25.3
90	3	1:40	28.8	28.3	28.0
100	3	1:40	33.0	30.6	28.4
Eucalyptus bark					
Temperature (°C)	Time (Hour)	Liqour ratio	% Total Solid		
			Distilled water	Methanol	Ethanol
50	3	1:40	11.0	10.8	6.7
60	3	1:40	12.0	11.1	6.9
70	3	1:40	12.3	11.6	8.1
80	3	1:40	13.0	12.0	9.0
90	3	1:40	13.2	12.8	10.0
100	3	1:40	14.2	13.1	12.0

From Table 4.1 when the extraction temperature is increased, percentage of total solid increases, by comparison, using distilled water as extractor yielded more percentage yield of total solid than methanol and ethanol at the same temperature.

Extraction of dye solution from leaves yielded more percentage of total solid than that form bark under the same conditions

From experimental result, as seen in Figure 4.1 and Figure 4.2, the eucalyptus dye extract from leaves and bark at 100^{O}C using solvent as distilled water, yielded more percentage of total solid than the other solvent and temperature.

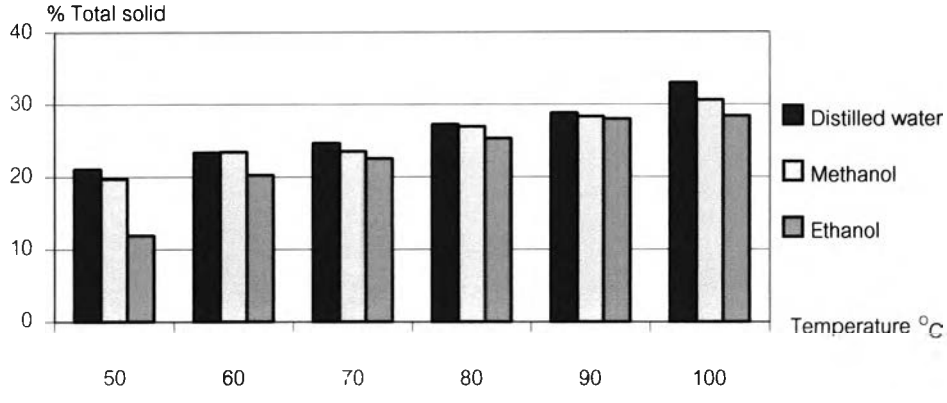

Figure. 4.1 The temperature for dye extraction from eucalyptus leaves

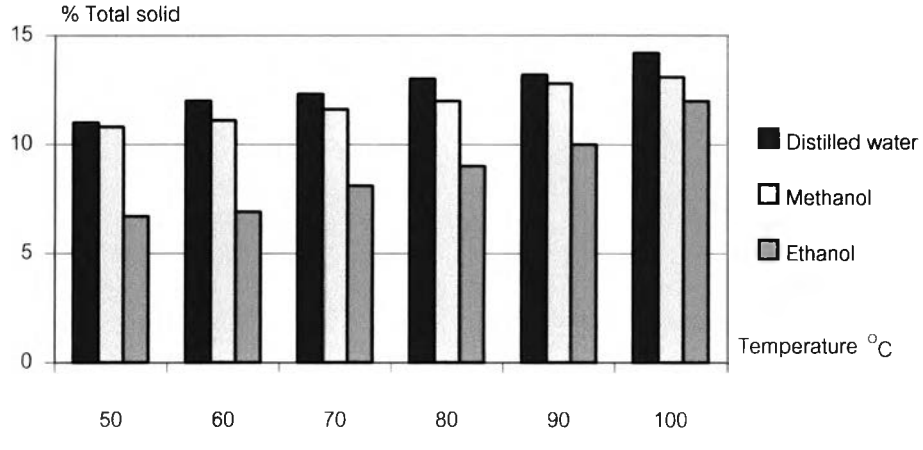

Figure 4.2 The temperature for dye extraction from eucalyptus bark

4.1.2 Appropriate time for dye extraction

Table 4.2 Percentage of total solid from dye extraction by varying time of extraction

Eucalyptus leaves					
Temperature (°C)	Time (Hour)	Liqour ratio	% Total Solid		
			Distilled water	Methanol	Ethanol
100	1	1:40	33.1	30.5	28.3
100	2	1:40	32.8	30.2	28.7
100	3	1:40	33.0	30.6	28.4
Eucalyptus bark					
Temperature (°C)	Time (Hour)	Liqour ratio	% Total Solid		
			Distilled water	Methanol	Ethanol
100	1	1:40	14.2	13.0	12.2
100	2	1:40	14.0	13.4	11.9
100	3	1:40	14.2	13.1	12.0

Table 4.2 shows that distilled water, methanol and ethanol were used as the solvent with duration 1 hours, 2 hours and 3 hours respectively.

From the experimental result, time of dye extraction was 1 hour and distilled water was used as solvent, yielded more percentage of total solid by comparing with the other solvents. This result is illustrated in Figure 4.3 and Figure 4.4.

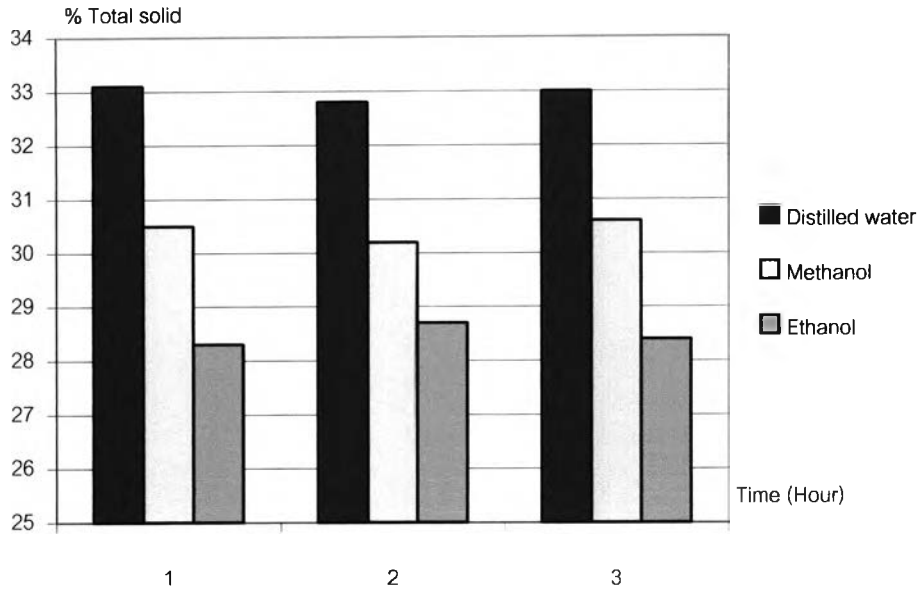

Figure 4.3 Time for dye extraction from eucalyptus leaves

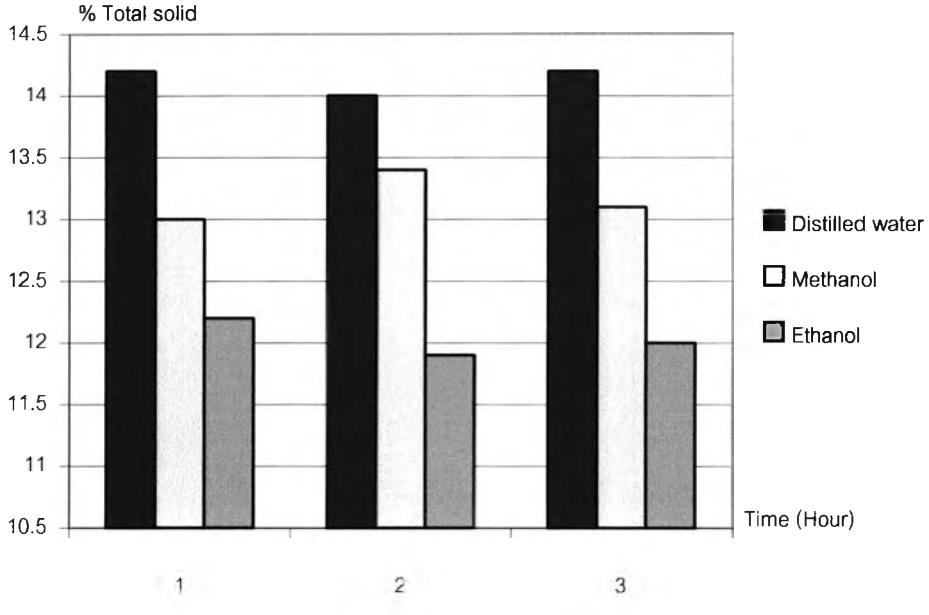

Figure 4.4 Time for dye extraction from eucalyptus bark

4.1.3 Appropriate liquor ratio of material and solvent for dye extraction

Table 4.3 Percentage of total solid from dye extraction by varying liquor ratio of material and solvent

Eucalyptus leaves					
Temperature (°C)	Time (Hour)	Liqour ratio	% Total Solid		
			Distilled water	Methanol	Ethanol
100	1	1:10	32.3	30.3	28.0
100	1	1:20	33.0	30.0	27.8
100	1	1:30	32.6	29.8	27.6
100	1	1:40	33.1	30.5	28.3
Eucalyptus bark					
Temperature (°C)	Time (Hour)	Liqour ratio	% Total Solid		
			Distilled water	Methanol	Ethanol
100	1	1:10	13.9	12.9	11.6
100	1	1:20	14.0	13.0	11.4
100	1	1:30	14.0	12.3	11.8
100	1	1:40	14.2	13.0	12.2

Table 4.3 show that the dye extraction by using distilled water, methanol and ethanol with liquor ratio was 1:10, 1:20, 1:30, and 1:40 respectively, Increasing liquor ratio yield almost constant percentage of total solid in each solvent.

From the experimental result, a condition of dye extraction with liquor ratio 1:40 and solvent was distilled water yielded more percentage of total solid than the other conditions. The result is illustrated in Figure 4.5 and Figure 4.6.

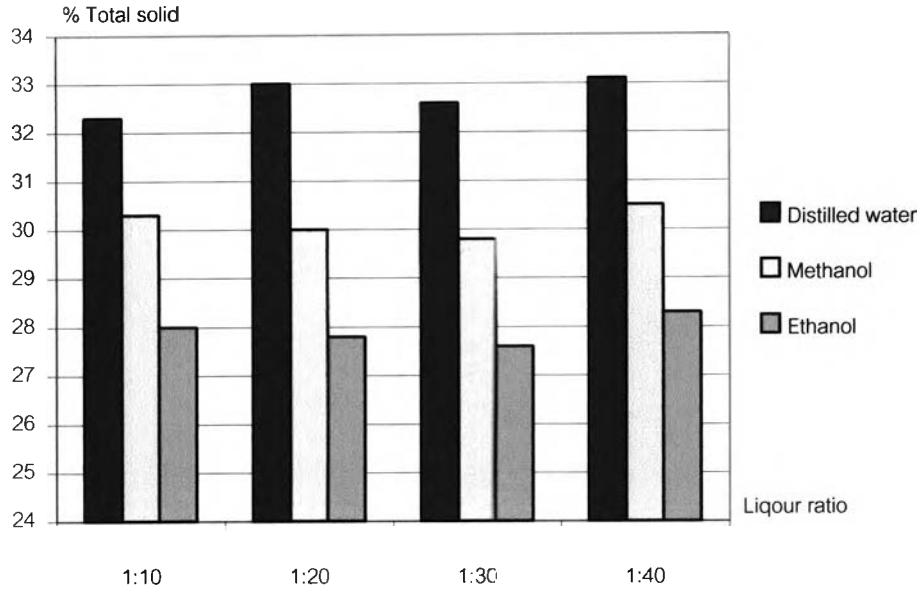

Figure 4.5 Liquor ratio for dye extraction from eucalyptus leaves

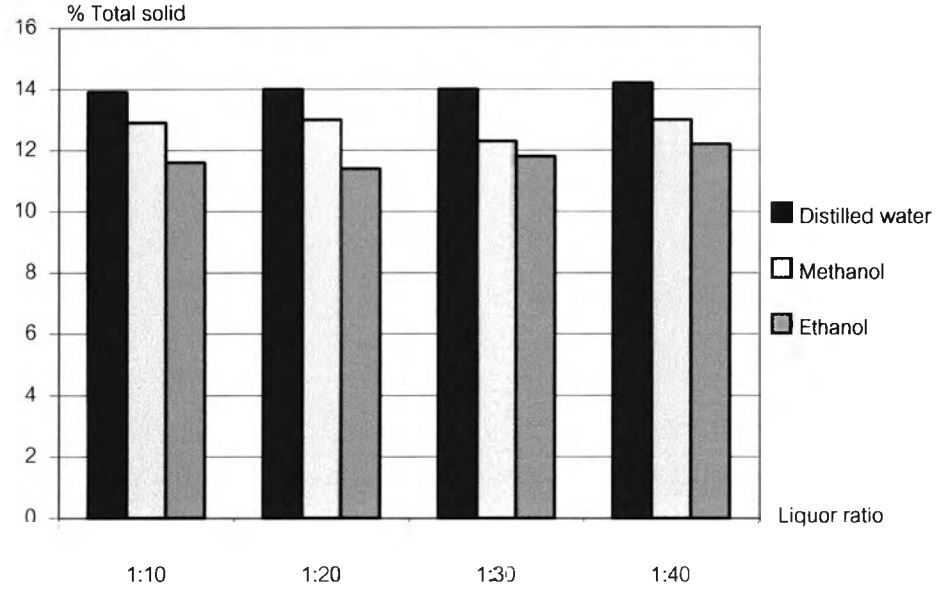

Figure 4.6 Liquor ratio for dye extraction from eucalyptus bark

4.2 Optimal condition for dyeing on silk and cotton fabrics

4.2.1 Optimal temperature for dyeing on silk and cotton fabrics

From the experiment in 3.3.2.1 to find the optimal temperature for dyeing silk and cotton fabric, the experimental result is shown in Table 4.4

Table 4.4 The ΔL* , Δa* , Δb* and K/S value of dyed silk and cotton fabrics by varying temperature of dyeing

Colour measurment	Dyeing Temperature (^{o}C)							
	30	40	50	60	70	80	90	100
Silk fabric dyed from								
Eucalytus leave								
ΔL*	-7.19	-10.69	-15.02	-17.13	-19.23	-22.51	-23.87	-23.80
Δa*	1.21	1.90	2.74	3.28	4.06	4.53	5.23	5.20
Δb*	14.29	17.21	19.05	19.98	20.83	20.75	20.59	20.5
K/S	1.5685	2.0984	2.7109	3.1344	3.4978	3.9656	4.0827	4.0120
Eucalyptus bark								
ΔL*	-13.62	-17.00	-19.51	-20.40	-24.43	-26.45	-30.58	-30.59
Δa*	5.86	7.21	8.21	8.60	10.27	11.70	12.92	12.93
Δb*	14.87	17.58	18.02	18.08	19.39	20.31	20.18	20.18
K/S	1.6038	2.1647	2.2658	2.2720	3.0013	3.3310	4.0187	4.0169
Cotton fabric dyed from								
Eucalyptus leave								
ΔL*	-8.28	-8.95	-8.93	-8.97	-8.54	-8.37	-9.34	-9.47
Δa*	0.97	1.10	1.14	1.10	1.05	1.12	1.27	1.53
Δb*	15.91	16.13	16.22	16.19	14.56	13.97	14.23	13.06
K/S	1.0168	1.0177	1.0291	1.0333	0.7262	0.7177	0.8026	0.6628
Eucalyptus bark								
ΔL*	-14.89	-15.79	-16.85	-16.35	-17.73	-13.98	-14.30	-14.68
Δa*	8.39	8.56	9.33	9.83	7.81	7.94	7.92	7.59
Δb*	19.19	19.07	18.72	18.80	17.33	15.95	15.98	15.64
K/S	1.0615	1.0600	1.0654	1.0674	0.7444	0.7553	0.7736	0.8004

Remark: Light source = D65, Observe degree = 10^{o},K/S (λ= 400 nm)

From Table 4.4, dyeing silk and cotton fabric in eucalyptus extracted from leaves and bark showed that the increasing temperature can increase the K/S value until reaching 90°C. The appearance colour of silk which dyed in eucalyptus leaves extract was yellow-brown colour, but dyed in eucalyptus bark extract was brown colour.

The dyed cotton fabric showed that the increasing temperature can increase the K/S value until reaching 60°C the K/S value was constant. The appearance colour of the leaves-extracted, dyed cotton was creamy yellow but dyed in eucalyptus bark extract was yellowish orange. The result from Table 4.4 fabric can be plotted as following.

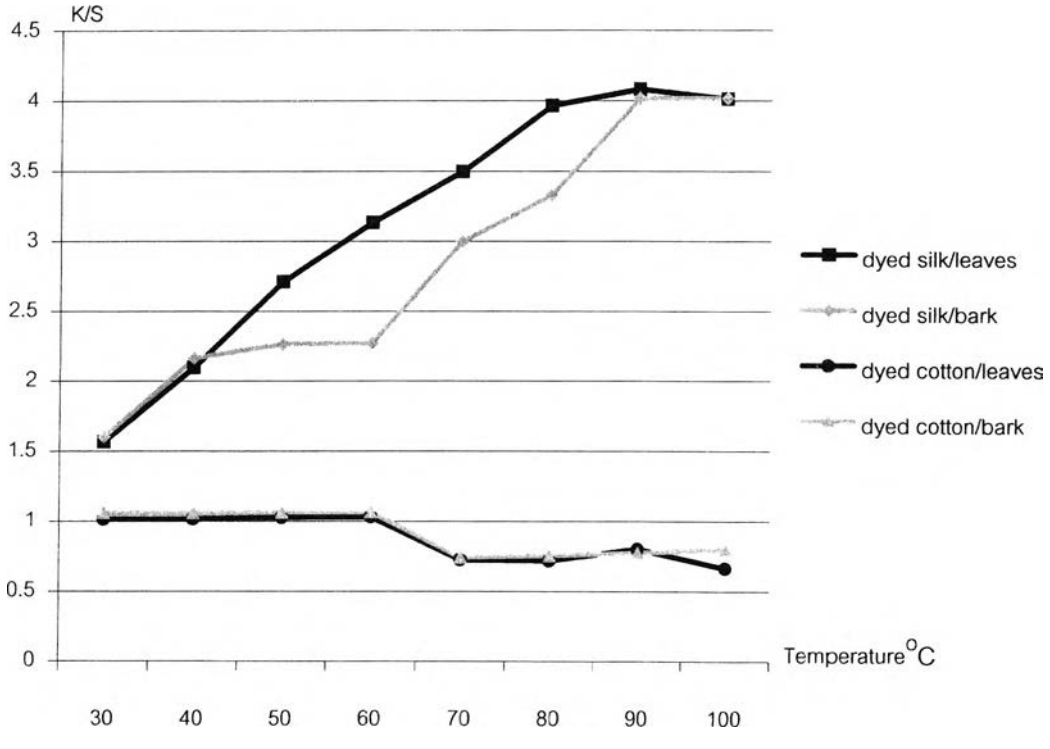

Figure 4.7 K/S value dyed silk and cotton fabrics by varying temperature of dyeing

4.2.2 Optimal time for dyeing on silk and cotton fabrics

From 3.3.2.2 experiment, the suitable time for dyeing silk and cotton was found the result is shown in Table 4.5

Table 4.5 The ΔL* , Δa* , Δb* and K/S value of dyed silk and cotton fabrics by varying time of dyeing

Colour measurment	Dyeing time (minutes)					
	10	20	30	40	50	60
Silk fabric dyed from						
Eucalytus leave						
ΔL*	-17.78	-20.83	-21.81	-23.80	-23.80	-23.78
Δa*	3.98	4.59	5.07	5.22	5.20	5.27
Δb*	19.02	19.23	20.04	20.57	20.45	20.40
K/S	2.7693	3.2819	3.5020	4.0825	4.0115	4.0100
Eucalyptus bark						
ΔL*	-20.44	-27.48	-26.93	-30.56	-30.59	-30.60
Δa*	8.60	10.61	10.65	12.91	12.90	12.87
Δb*	18.08	18.66	18.65	20.15	20.17	19.96
K/S	2.2720	3.3477	3.3563	4.0180	4.0160	4.0157
Cotton fabric dyed from						
Eucalyptus leave						
ΔL*	-5.31	-6.63	-7.41	-8.97	-8.93	-8.95
Δa*	0.16	0.36	0.42	1.09	1.14	1.10
Δb*	11.70	13.06	13.10	16.18	16.22	16.13
K/S	0.5425	0.6373	0.7000	1.0330	1.0290	1.0177
Eucalyptus bark						
ΔL*	-11.86	-12.00	-13.59	-16.30	-16.85	-15.79
Δa*	5.51	6.58	7.68	9.81	9.33	8.56
Δb*	13.49	15.22	16.65	18.80	18.72	19.07
K/S	0.5883	0.6544	0.8059	1.0674	1.0654	1.0600

Remark: Light source = D65, Observe degree = 10°,K/S (λ= 400 nm)

From Table 4.5, when the time in dyeing silk and cotton fabric was increased, the K/S value increased. After 40 minutes, the K/S va ue was constant. The result can be illustrated as following.

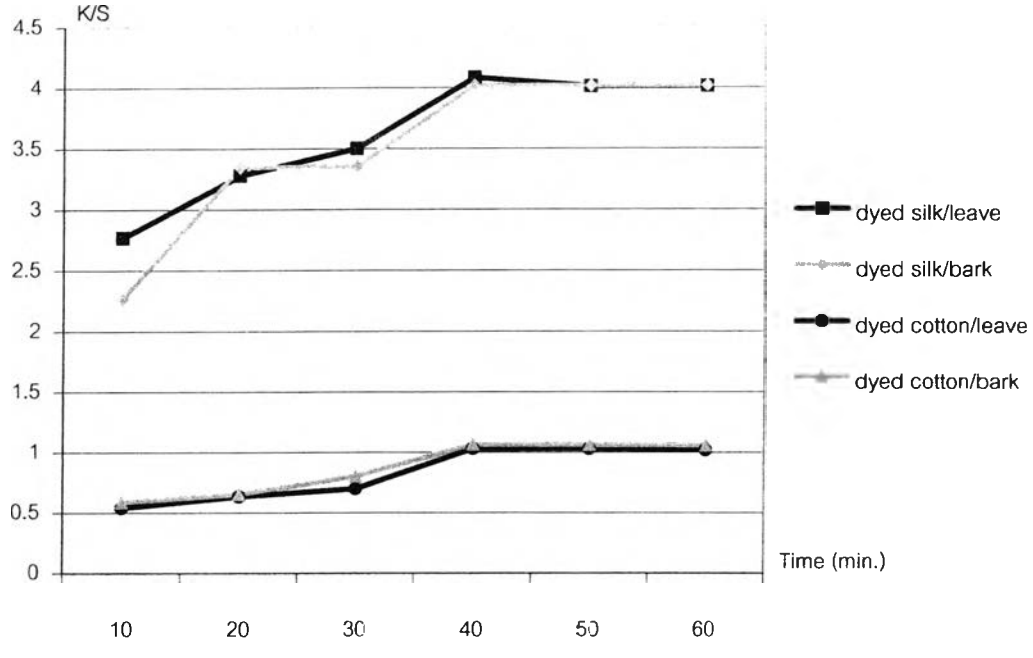

Figure 4.8 K/S value dyed silk and cotton fabrics by varying time of dyeing

4.2.3 Optimal liquor ratio for dyeing on silk and cotton fabrics

From the experimental result of 3.3.2.3, which aimed to find out the optimal liquor ratio of fabric and dye solution for cotton and silk dyeing, the result is illustrated in Table 4.6.

Table 4.6 The ΔL* , Δa* , Δb* and K/S value of dyed silk and cotton fabrics by varying liquor ratio of dyeing

Colour measurment	Dyeing Liquor ratio				
	1:10	1:20	1:30	1:40	1:50
Silk fabric dyed from					
Eucalytus leave					
ΔL*	-22.51	-23.80	-23.78	-23.80	-23.82
Δa*	4.53	5.20	5.27	5.21	5.20
Δb*	20.75	20.50	20.40	20.45	20.48
K/S	3.9656	4.0120	4.0100	4.0115	4.0820
Eucalyptus bark					
ΔL*	-30.59	-30.58	-30.59	-30.60	-30.55
Δa*	12.93	12.92	12.90	18.80	12.92
Δb*	20.18	20.17	20.15	19.98	20.15
K/S	4.0169	4.0170	4.0160	4.0158	4.0183
Cotton fabric dyed from					
Eucalyptus leave					
ΔL*	-8.95	-8.93	-8.95	-8.93	-8.95
Δa*	1.10	1.14	1.10	1.14	1.09
Δb*	16.13	16.22	16.19	16.22	16.15
K/S	1.0177	1.0291	1.0333	1.0291	1.0300
Eucalyptus bark					
ΔL*	-15.79	-14.39	-16.35	-15.79	-16.30
Δa*	8.56	8.39	9.83	8.56	9.80
Δb*	19.07	19.19	18.83	19.07	18.78
K/S	1.0600	1.0615	1.0674	1.0600	1.0670

Remark: Light source = D65, Observe degree = 10^{o},K/S (λ= 400 nm)

Table 4.6 presents the K/S value results with different L:R. The fabrics after dyeing with L:R 1:10 and 1:20, showed the uneven dyeing appearance. However, when the L:R increased to 1:30 – 1:50, the dyeing appearance were even. The result from Table 4.6 can be illustrated as following Figure 4.9.

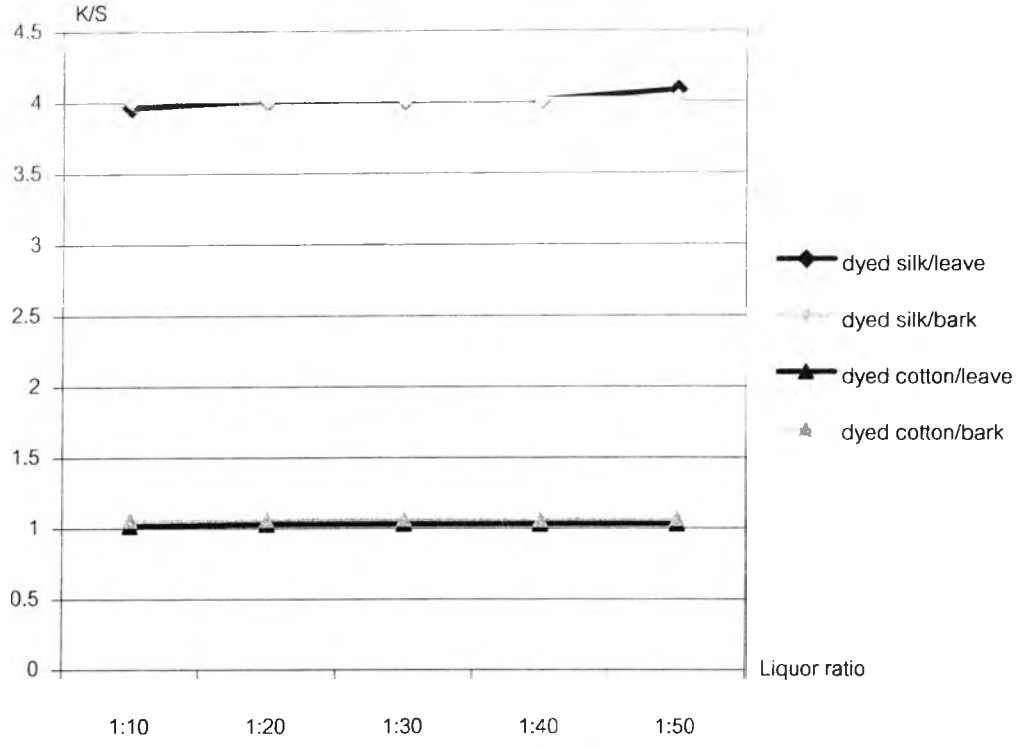

Figure 4.9 K/S value for dyed silk and cotton fabrics by varying liquor ratio of dyeing

4.2.4 Optimal pH value for dyeing on silk and cotton fabrics

The 3.3.2.4 experiment is to find the suitable pH value for dyeing silk and cotton fabric. The result of experiment can be concluded as following Table 4.7

Table 4.7 The ΔL* , Δa* , Δb* and K/S value of dyed silk and cotton fabrics by varying pH value of dyeing

Colour measurment	Dyeing pH value							
	No adjusted	4	5	6	7	8	9	10
Silk fabric dyed from								
Eucalytus leave								
ΔL*	-23.75	-37.09	-33.14	-27.89	-22.58	-	-	-
Δa*	5.27	6.60	5.76	4.89	4.48	-	-	-
Δb*	20.38	23.01	21.23	19.90	18.62	-	-	-
K/S	4.0111	7.0272	4.9663	3.3285	2.2915	-	-	-
Eucalyptus bark								
ΔL*	-30.57	-43.35	-38.07	-30.00	-27.89	-	-	-
Δa*	12.88	15.68	14.61	11.38	10.93	-	-	-
Δb*	20.12	18.73	18.17	18.45	17.67	-	-	-
K/S	4.0157	5.8372	4.2163	2.7612	2.3321	-	-	-
Cotton fabric dyed from								
Eucalyptus leave								
ΔL*	-8.95	-	-	-	-8.28	-9.34	-8.54	-9.47
Δa*	1.10	-	-	-	0.97	1.27	1.05	1.53
Δb*	16.15	-	-	-	15.91	14.23	14.56	13.06
K/S	1.0334	-	-	-	1.0168	0.8026	0.7262	0.6628
Eucalyptus bark								
ΔL*	-16.33	-	-	-	-14.89	-14.68	-14.30	-13.98
Δa*	9.85	-	-	-	8.30	7.59	7.92	7.90
Δb*	19.12	-	-	-	19.10	15.63	15.90	15.90
K/S	1.0618	-	-	-	1.0610	0.8000	0.7735	0.7730

Remark: Light source = D65, Observe degree = 10°,K/S (λ = 400 nm)

From the pH value experiment, the pH value of eucalyptus leaves dyed solution was 5.7, but from bark was 6.2. From Table 4.7, pH value at 4.0 was the best result for dyeing silk fabric when compared with the other pH value. When increasing pH value, K/S value was declined. Without adjusting pH value when dyed cotton, gained darken hue value than the other pH value. The K/S value declined when pH value increased, as seen in Figure 4.10

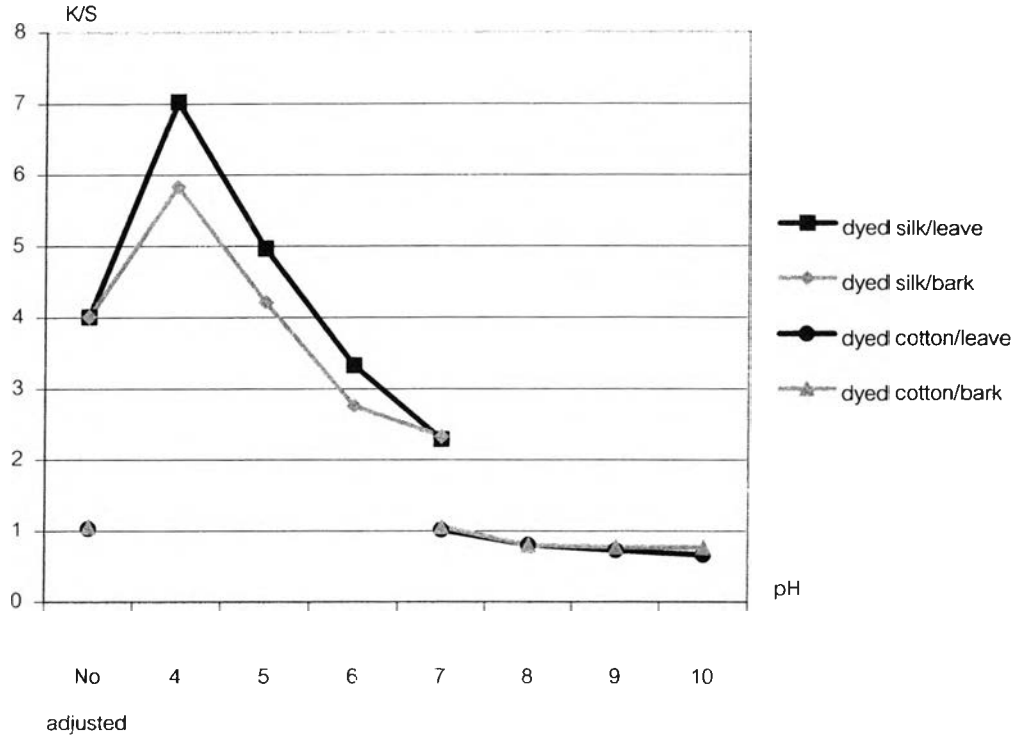

Figure 4.10 K/S value for dyed silk and cotton fabrics by varying pH value of dyeing

4.3 Optimal condition for pre-mordant on silk and cotton fabrics

4.3.1 Optimal temperature for pre-mordant on silk and cotton fabrics

The 3.3.3.1 experiment, was to find the suitable temperature for pre-mordant process on silk and cotton fabrics which varied the four substances of mordant compound as following Table 4.8 and Table 4.9

Table 4.8 The ΔL* , Δa* , Δb* and K/S value of pre-mordanted silk fabric by varying temperature of pre-mordanting

Pre-mordant temperature (°C)	Colour measurement D65/ 10°	Pre-mordant on silk fabric							
		Dye solution from							
		Eucalyptus leaves				Eucalyptus bark			
		Al	Cu	Fe	Sn	Al	Cu	Fe	Sn
30	ΔL*	-24.35	-37.85	-65.20	-17.14	-31.98	-38.77	-46.83	-17.31
	Δa*	3.49	6.77	1.61	3.21	12.00	6.61	3.30	7.44
	Δb*	25.25	24.16	-0.55	34.24	19.15	19.40	7.05	21.31
	K/S	4.6282	6.4163	10.940	6.1258	3.7160	5.3740	5.1594	2.5122
40	ΔL*	-24.43	-37.05	-65.00	16.60	-32.81	-38.62	-46.50	-17.92
	Δa*	3.39	6.75	1.65	2.70	12.48	7.03	3.70	7.85
	Δb*	25.90	24.43	-0.51	34.41	19.70	19.78	8.82	21.40
	K/S	4.7666	6.2845	10.910	6.1012	3.7885	5.3593	5.7012	2.5262
50	ΔL*	-25.01	-38.13	-65.67	-17.15	-32.10	-39.69	-46.70	-17.18
	Δa*	3.81	6.80	1.88	3.21	12.20	6.94	3.27	7.42
	Δb*	25.15	24.30	-0.99	34.27	19.25	19.99	7.00	21.00
	K/S	4.7546	6.7201	10.875	6.1255	3.7540	5.8085	5.1500	2.5099
60	ΔL*	-25.81	-37.14	-65.71	-17.43	-32.50	-39.74	-46.91	-16.59
	Δa*	4.41	6.66	1.75	3.28	12.48	6.48	3.32	7.16
	Δb*	25.72	23.88	-0.57	35.05	19.37	19.76	6.59	21.70
	K/S	4.7726	6.1547	10.9000	6.6569	3.7210	5.8254	5.2646	2.5959
70	ΔL*	-24.14	-38.15	-65.05	-17.10	-32.84	-39.95	-47.19	-18.04
	Δa*	3.60	6.84	1.69	3.20	12.14	7.42	3.33	7.56
	Δb*	24.98	24.26	-0.53	34.25	19.67	20.17	7.12	20.84
	K/S	4.5963	6.7301	10.913	6.1260	3.8164	5.9233	5.5015	2.4452

Table 4.8 The ΔL* , Δa* , Δb* and K/S value of pre-mordanted silk fabrics by varying temperature of pre-mordanting (continue)

Pre-mordant temperature (^{o}C)	Colour measurement D65/ 10^{o}	Pre-mordant on silk fabric							
		Dye solution from							
		Eucalyptus leaves				Eucalyptus bark			
		Al	Cu	Fe	Sn	Al	Cu	Fe	Sn
80	ΔL*	-24.05	-36.98	-65.23	-17.75	-31.93	-38.72	-46.56	-17.93
	Δa*	3.88	6.28	1.60	3.08	11.65	6.90	3.72	8.11
	Δb*	25.17	23.43	-0.57	32.80	19.12	19.93	8.83	21.51
	K/S	4.6114	6.1449	10.949	6.3641	3.7057	5.5070	5.7165	2.5546
90	ΔL*	-24.30	-37.80	-66.41	-19.04	-32.31	-39.89	-46.85	-16.22
	Δa*	3.45	6.70	1.55	3.46	12.26	7.11	3.30	6.93
	Δb*	25.23	24.14	-1.26	31.48	19.28	19.21	6.55	20.02
	K/S	4.6220	6 4012	11.075	6.2159	3.7600	5.6253	5.2440	2.4486
100	ΔL*	-24.08	-35.95	-66.20	-17.78	-32.30	-39.89	-46.80	-17.91
	Δa*	3.80	6.43	1.25	3.10	12.25	7.10	3.29	7.87
	Δb*	25.10	24.09	-1.02	32.81	19.28	19.21	7.06	21.39
	K/S	4.6110	6.3561	11.019	6.3742	3.7563	5.6094	5.1593	2.5260

Remark: K/S (λ= 400 nm)

Table 4.9 The ΔL* , Δa* , Δb* and K/S value of pre-mordanted cotton fabric by varying temperature of pre-mordanting

Pre-mordant temperature (°C)	Colour measurement D65/ 10°	Pre-mordant on cotton fabric							
		Dye solution from							
		Eucalyptus leaves				Eucalyptus bark			
		Al	Cu	Fe	Sn	Al	Cu	Fe	Sn
30	ΔL*	-14.26	-13.76	-41.09	-17.37	-13.21	-14.49	-23.91	-21.20
	Δa*	0.91	2.51	2.94	3.70	6.40	6.36	3.46	11.32
	Δb*	24.05	19.66	5.24	25.30	16.33	13.63	8.78	21.12
	K/S	3.0633	1.2364	3.3890	5.1195	0.8640	0.7314	1.0012	2.3060
40	ΔL*	-14.23	-13.65	-40.72	-18.09	-13.62	-14.60	-24.13	-20.60
	Δa*	0.97	2.61	3.34	4.02	6.60	6.40	3.51	11.43
	Δb*	24.40	20.16	5.71	25.73	16.19	13.50	8.20	20.78
	K/S	3.1750	1.2700	3.4027	5.3072	0.8729	0.7200	1.0517	2.1798
50	ΔL*	-15.11	-13.70	-41.55	-17.40	-13.50	-15.15	-24.00	22.89
	Δa*	0.98	2.58	3.20	3.70	6.55	6.69	3.47	11.98
	Δb*	25.44	20.43	5.29	25.32	15.71	13.87	8.18	21.11
	K/S	3.6299	1.2391	3.5818	5.1201	0.8178	0.7486	1.0414	2.4816
60	ΔL*	-15.02	-13 64	-41.00	-18.94	-13.46	-15.15	-24.61	-22.94
	Δa*	1.35	2.55	2.90	4.38	6.57	6.69	3.50	11.40
	Δb*	24.17	19.60	5.20	26.24	16.16	13.87	8.60	21.18
	K/S	3.1885	1.2200	3.3701	5.6772	0.8200	0.7486	1.0912	2.3262
70	ΔL*	-13.81	-13.78	-40.63	-18.10	-13.85	-15.58	-24.90	-22.88
	Δa*	0.69	2.69	3.17	4.06	6.69	6.26	3.53	11.96
	Δb*	25.38	20.09	5.25	25.75	15.69	13.70	8.52	21.10
	K/S	3.5046	1.2800	3.3412	5.3171	0.8803	0.7056	1.095	2.4616

Table 4.9 The ΔL* , Δa* , Δb* and K/S value of pre-mordanted cotton fabrics by varying temperature of pre-mordanting (continue)

Pre-mordant temperature (°C)	Colour measurement D65/ 10°	Pre-mordant on cotton fabric							
		Dye solution from							
		Eucalyptus leaves				Eucalyptus bark			
		Al	Cu	Fe	Sn	Al	Cu	Fe	Sn
80	ΔL*	-14.69	-13.75	-43.18	-18.89	-13.64	-14.66	-22.00	-21.53
	Δa*	1.16	2.60	3.21	4.46	6.65	6.41	3.45	3.35
	Δb*	24.79	20.00	5.06	25.77	16.15	13.98	8.84	8.84
	K/S	3.3297	1.2416	3.9078	5.3386	0.8730	0.7421	1.0675	2.6293
90	ΔL*	-15.12	-13.76	-40.62	-18.93	-13.51	-15.60	-22.94	-22.80
	Δa*	0.95	2.53	3.16	4.36	6.58	6.80	3.56	11.90
	Δb*	25.46	20.16	5.23	26.20	16.31	14.02	8.85	21.10
	K/S	3.6300	1.2679	3.3301	5.6672	0.8610	0.7804	1.0034	2.4016
100	ΔL*	-14.75	-13.86	-40.63	-18.80	-13.20	-14.67	-22.50	-20.63
	Δa*	1.03	2.68	3.16	4.40	6.41	6.40	3.60	11.44
	Δb*	25.56	20.21	5.24	25.71	16.35	13.53	9.91	20.79
	K/S	3.5576	1.2789	3.8181	5.3280	0.8739	0.7289	1.0990	2.1850

Remark: K/S (λ= 400 nm)

Tables 4.8 and 4.9 showed that the range of temperature form 30°C – 100°C yielded the similar result of K/S value. Silk dyed in the solution extracting from the leaves and bark of eucalyptus with mordant compound were generally found to yield dye colours in varying shade of brown. Except fabric using Fe mordant had shown shade of dark grey. The result of cotton had shown shade of yellow-orange except fabric using Fe mordant had shown shade pale-grey. The results form Tables 4.8 and 4.9 can be illustrated as following Figure 4.11 to Figure 4.14.

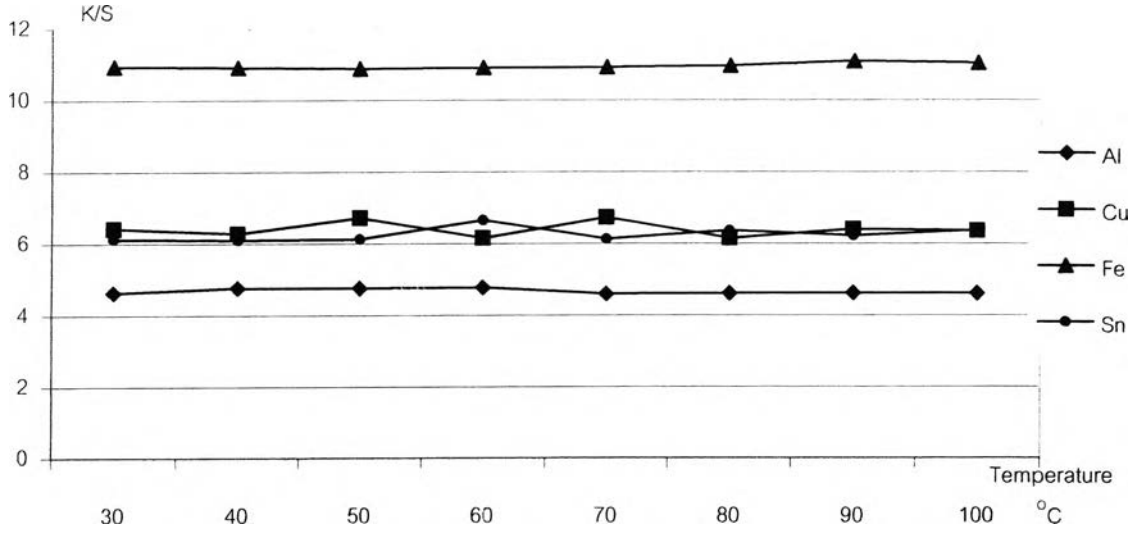

Figure 4.11 K/S value for dyed silk from eucalyptus leaves by varying pre-mordant temperature

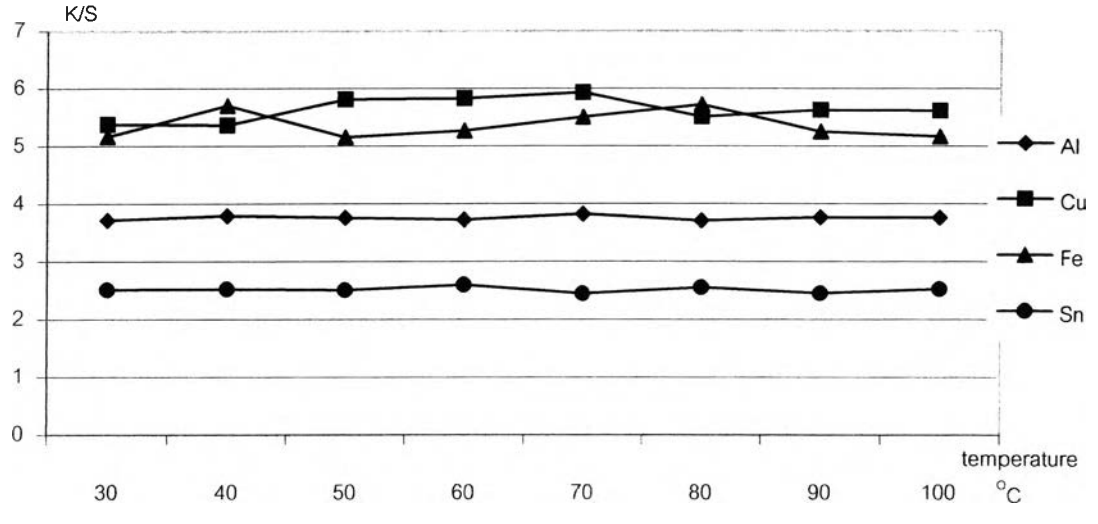

Figure 4.12 K/S value for dyed silk from eucalyptus bark by varying pre-mordant temperature

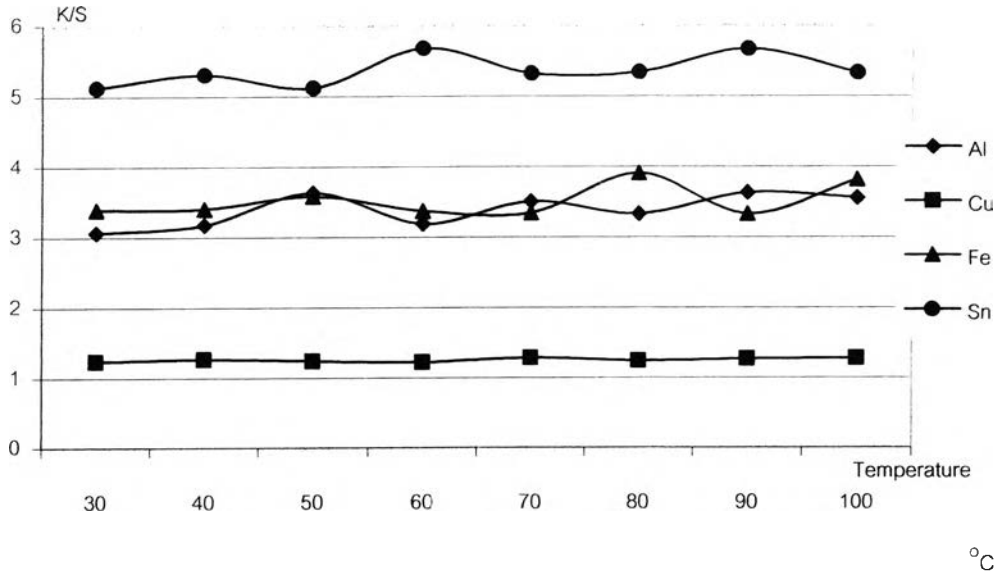

Figure 4.13 K/S value for dyed cotton from eucalyptus leaves by varying pre-mordant temperature

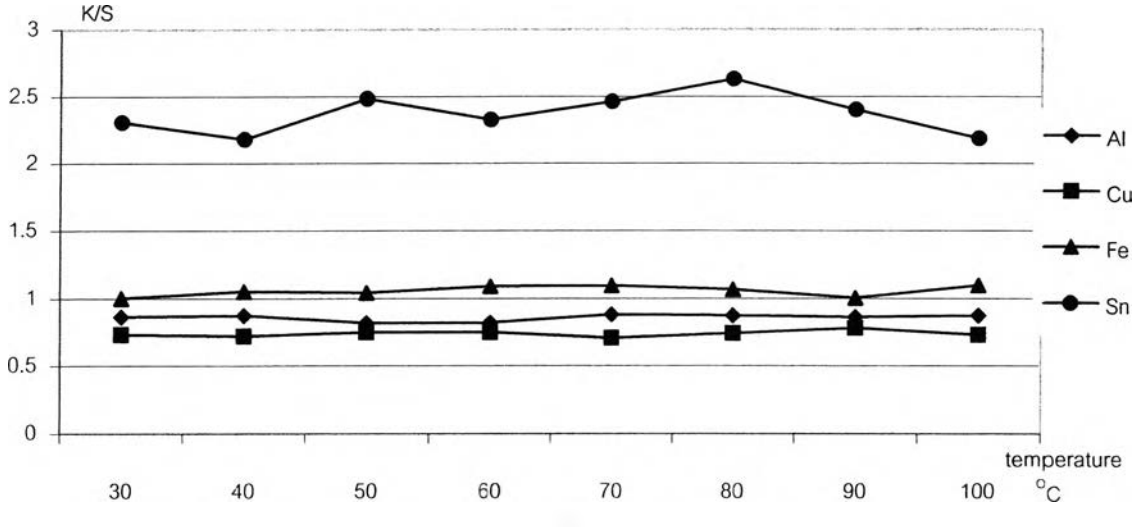

Figure 4.14 K/S value for dyed cotton from eucalyptus bark by varying pre-mordant temperature

4.3.2 Optimal time for pre-mordant on silk and cotton fabrics

From 3.3.3.2 experiment to find the suitable time for pre-mordant on cotton and silk fabric by varied the four substance of mordant. The results are illustrated in Table 4.10 and Table 4.11.

Table 4.10 The ΔL^*, Δa^*, Δb^*, and K/S value of pre-mordanted silk fabric by varying time of pre-mordanting

Pre-mordant time (min)	Colour measurement D65/ 10^o	Pre-mordant on silk fabric							
		Dye solution from							
		Eucalyptus leaves				Eucalyptus bark			
		Al	Cu	Fe	Sn	Al	Cu	Fe	Sn
10	ΔL^*	-24.43	-40.22	-63.18	-17.43	-32.10	-37.92	-46.50	-20.10
	Δa^*	3.39	7.60	1.45	3.28	12.20	7.05	3.70	9.02
	Δb^*	25.90	20.57	0.51	35.05	19.25	20.08	8.82	22.15
	K/S	4.7666	6.1964	10.288	6.6569	3.7540	5.4236	5.7012	2.8926
20	ΔL^*	-25.81	-37.85	-65.67	-17.75	-32.50	-39.76	-46.70	-18.19
	Δa^*	4.41	6.77	1.88	3.08	12.48	6.76	3.27	7.74
	Δb^*	25.72	24.16	0.99	32.80	19.37	18.93	7.01	21.98
	K/S	4.7726	6.4163	10.875	6.3641	3.7210	5.5932	5.1500	2.8617
30	ΔL^*	-24.14	-37.05	-63.51	-17.14	-31.93	-38.07	-47.19	-18.60
	Δa^*	3.60	6.75	1.80	3.21	11.65	6.75	3.33	8.06
	Δb^*	24.98	24.43	0.16	34.24	19.12	19.25	7.12	20.86
	K/S	4.5963	6.2845	10.495	6.1258	3.7057	5.535	5.5015	2.5486
40	ΔL^*	-24.30	-38.13	-64.07	-20.15	-31.98	-39.57	-46.83	-18.37
	Δa^*	3.43	6.80	1.92	4.47	12.00	7.25	3.30	7.99
	Δb^*	25.23	24.30	0.49	33.46	19.15	19.58	7.05	21.25
	K/S	4.6220	6.7201	10.815	6.3671	3.7160	5.6152	5.1594	2.5892
50	ΔL^*	-24.35	-37.85	-65.20	-17.14	-31.98	-38.77	-46.83	-17.31
	Δa^*	3.49	6.77	1.61	3.20	12.10	6.60	3.30	7.44
	Δb^*	25.25	24.15	-0.55	34.24	19.15	19.38	7.05	21.31
	K/S	4.6282	6.4163	10.941	6.1257	3.7161	5.3739	5.1594	2.5122

Remark: K/S (λ= 400 nm)

Table 4.11 The ΔL^*, Δa^*, Δb^*, and K/S value of pre-mordanted cotton fabric by varying time of pre-mordanting

Pre-mordant time (min)	Colour measurement D65/ 10^o	Pre-mordant on cotton fabric							
		Dye solution from							
		Eucalyptus leaves				Eucalyptus bark			
		Al	Cu	Fe	Sn	Al	Cu	Fe	Sn
10	ΔL*	-14.75	-19.76	-40.63	-18.80	-13.20	-14.67	-22.50	-20.63
	Δa*	1.03	8.71	3.16	4.40	6.41	6.40	3.60	11.44
	Δb*	25.56	18.61	5.24	25.70	16.35	13.50	9.91	20.79
	K/S	3.5576	1.3801	3.8181	5.3280	0.8739	0.7289	1.0990	2.1850
20	ΔL*	-15.12	-17.85	-40.62	-18.89	-13.51	-14.66	-22.94	-21.53
	Δa*	0.95	7.91	3.16	4.46	6.58	6.41	3.56	3.35
	Δb*	25.46	17.87	5.23	25.77	16.31	13.98	8.85	8.84
	K/S	3.6300	1.2795	3.3301	5.3386	0.8610	0.7421	1.0034	2.6293
30	ΔL*	-13.81	-17.37	-40.63	-18.94	-13.62	-15.58	-24.90	-22.94
	Δa*	0.69	7.77	3.17	4.38	6.60	6.26	3.53	11.40
	Δb*	25.38	17.96	5.25	26.24	16.19	13.70	8.52	21.18
	K/S	3.5046	1.2715	3.3412	5.6772	0.8729	0.7056	1.095	2.3262
40	ΔL*	-15.02	-13.65	-41.55	-18.09	-13.85	-15.15	-24.13	-20.60
	Δa*	1.35	2.61	3.20	4.02	6.69	6.69	3.51	11.43
	Δb*	24.17	20.16	5.29	25.73	15.69	13.87	8.20	20.78
	K/S	3.1885	1.2700	3.5818	5.3073	0.8803	0.7486	1.0517	2.1798
50	ΔL*	-14.26	-13.76	-41.09	-17.37	-13.21	-14.49	-23.91	-21.20
	Δa*	0.91	2.51	2.91	3.69	6.40	6.36	3.45	11.32
	Δb*	24.05	19.66	5.24	25.28	16.32	13.63	8.76	21.12
	K/S	3.0633	1.2364	3.3890	5.1194	0.8641	0.7312	1.0011	2.3060

Remark: K/S (λ= 400 nm)

From Table 4.10 and Table 4.11, it is found that varied the time from 10 – 50 minutes gained the approximate result of K/S value. As shown in Figure 4.15 to Figure 4.18.

Figure 4.15 to Figure 4.18 showed that the increasing time for mordant treated could not increase the K/S value and dye absorption on silk and cotton fabric were constant under the same condition.

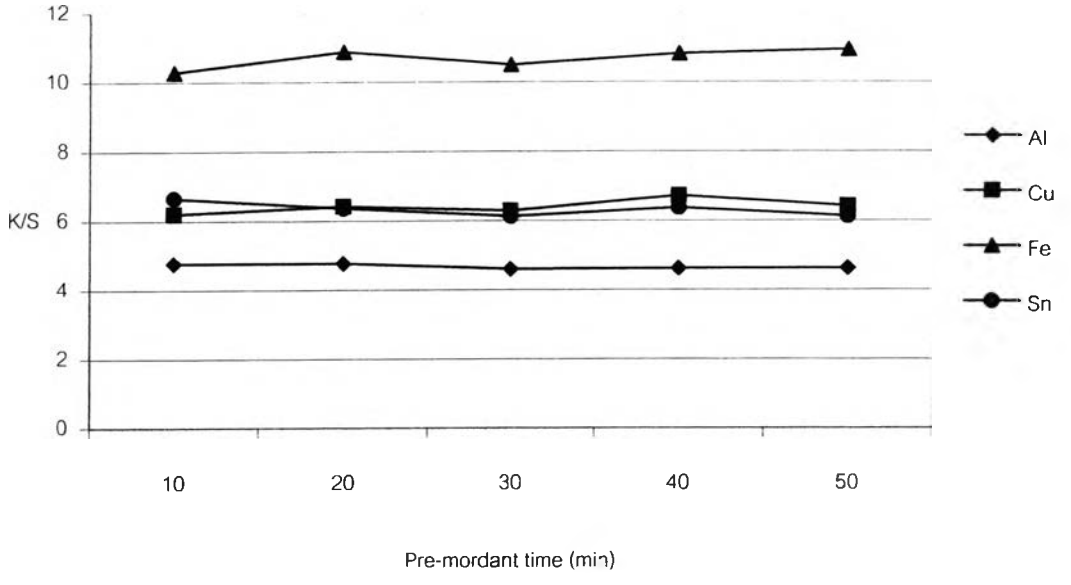

Figure 4.15 K/S value for dyed silk from eucalyptus leaves by varying pre-mordant time

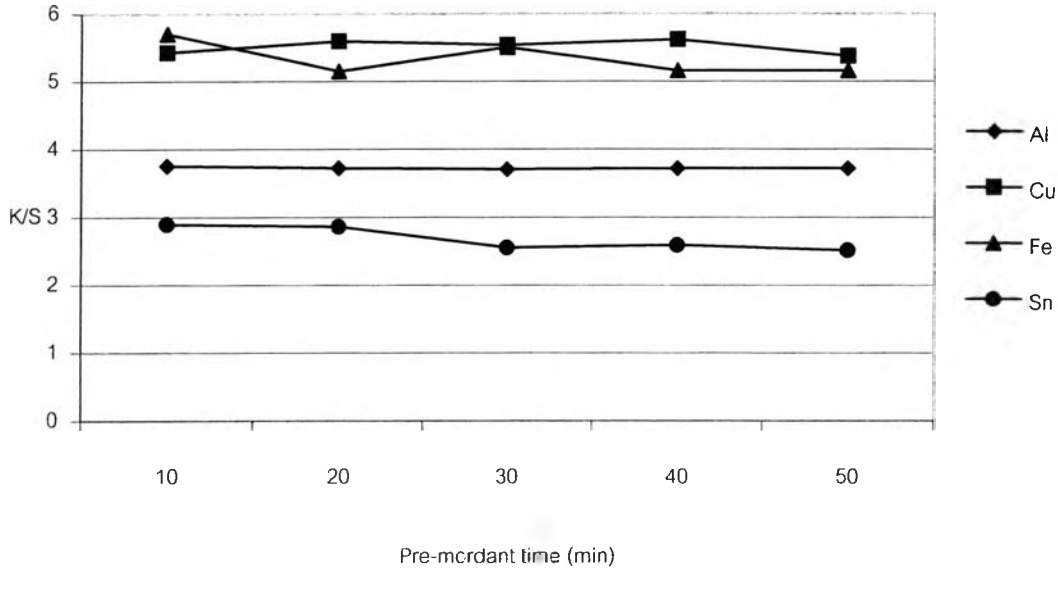

Figure 4.16 K/S value for dyed silk from eucalyptus bark by varying pre- mordant time

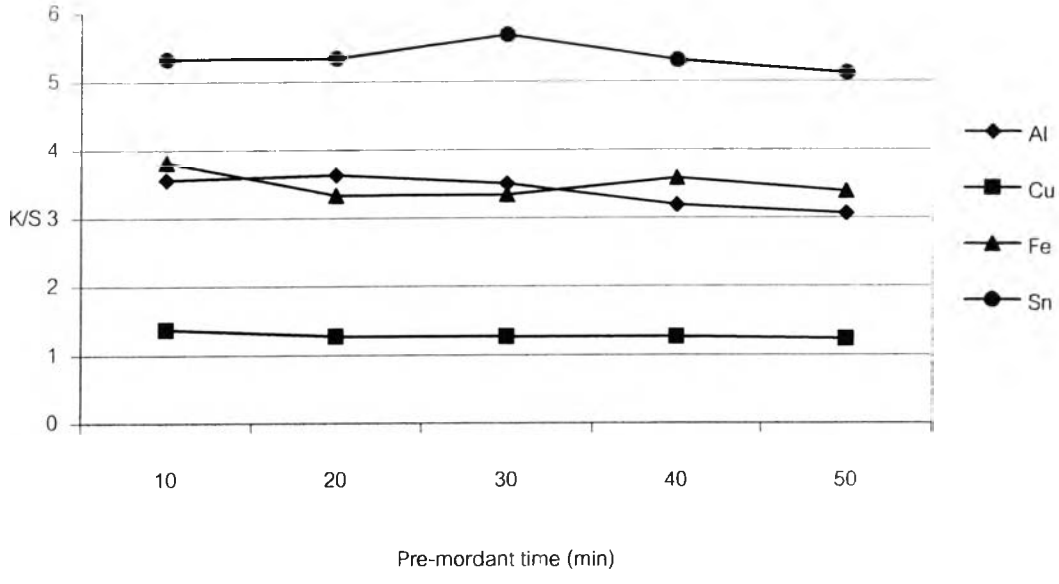

Figure 4.17 K/S value for dyed cotton from eucalyptus leaves by varying pre-mordant time

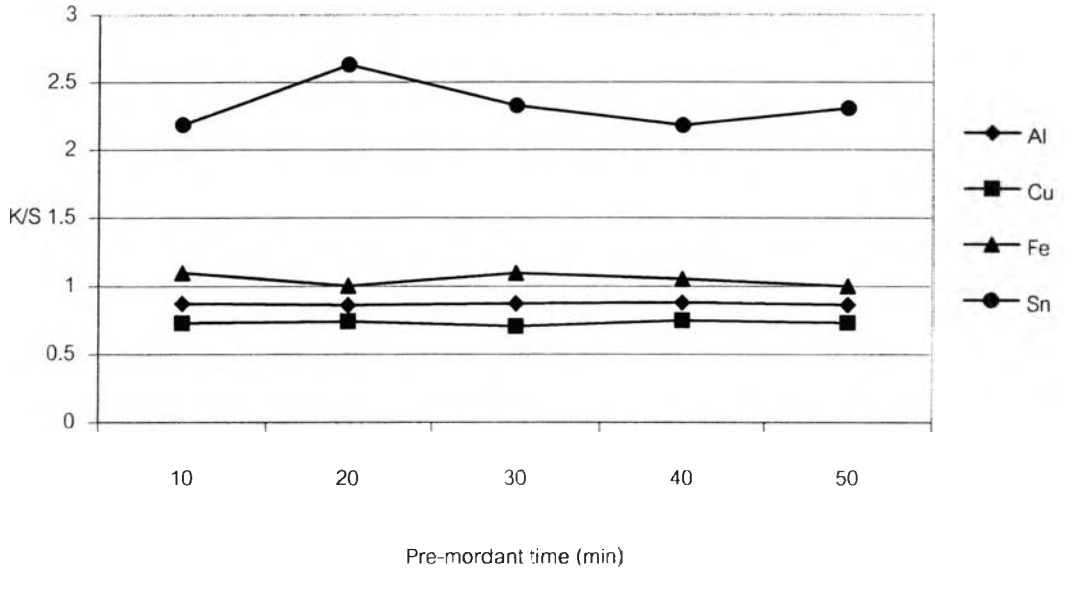

Figure 4.18 K/S value for dyed cotton from eucalyptus bark by varying pre-mordant time

4.3.3 Optimal quantity of mordant compound for pre-mordant on silk and cotton fabrics

The 3.3.3.3 experiment is to find the suitable quantity of mordant compound on silk and cotton fabric. The results are shown in Table 4.12.

Table 4.12 The ΔL^*, Δa^*, Δb^*, and K value of pre-mordanted silk fabric by varying quantity of mordant compound

Quantity of mordant compound (%owf)	Colour measurement D65/ 10°	Pre-mordant on silk fabric							
		Dye solution from							
		Eucalyptus leaves				Eucalyptus bark			
		Al	Cu	Fe	Sn	Al	Cu	Fe	Sn
0.1	ΔL*	-24.91	-40.2	-63.18	-17.43	-32.10	-37.92	-46.50	-20.10
	Δa*	3.40	7.60	1.45	3.28	12.20	7.05	3.70	9.02
	Δb*	25.90	20.57	0.51	35.05	19.25	20.08	8.82	22.15
	K/S	4.7665	6.1965	10.288	6.6569	3.7540	5.4236	5.7012	2.8926
0.5	ΔL*	-29.05	-36.19	-66.41	-16.87	-28.29	-38.18	-46.85	-18.87
	Δa*	11.23	6.46	1.55	2.20	10.71	6.30	3.30	8.91
	Δb*	16.95	24.08	1.26	27.76	15.72	17.17	6.55	17.81
	K/S	4.3268	6.2190	11.075	6.3109	3.9421	5.1097	5.2440	2.7404
1.0	ΔL*	-24.08	-35.90	-65.05	-16.95	-27.91	-38.68	-47.19	-18.00
	Δa*	3.80	6.52	1.69	2.44	10.67	6.04	3.33	8.68
	Δb*	25.10	24.22	0.58	28.19	16.45	17.32	7.12	17.65
	K/S	4.6110	6.2647	10.913	6.2370	3.9688	5.3744	5.5015	2.5964
1.5	ΔL*	-24.14	-34.72	-65.67	-17.78	-27.17	-38.41	-46.70	-18.44
	Δa*	3.60	6.08	1.88	3.10	10.47	6.10	3.27	9.03
	Δb*	24.98	24.15	0.99	32.81	15.36	17.27	7.00	18.65
	K/S	4.5963	6.0875	10.875	6.3742	3.6331	5.2378	5.1500	2.9940
2.0	ΔL*	-25.01	-36.06	-65.71	-17.10	-32.30	-40.01	-46.91	-19.40
	Δa*	3.81	6.52	1.75	3.20	12.25	6.67	3.32	9.54
	Δb*	25.15	24.81	0.57	34.25	19.28	17.98	6.59	18.70
	K/S	4.7546	6.5375	10.9000	6.1260	3.7563	5.8905	5.2646	2.8947

Remark: K/S (λ= 400 nm)

Table 4.13 The ΔL^*, Δa^*, Δb^*, and K/S value of pre-mordanted cotton fabric by varying quantity of mordant compound

Quantity of mordant compound (%owf)	Colour measurement D65/ 10°	Pre-mordant on cotton fabric							
		Dye solution from							
		Eucalyptus leaves				Eucalyptus bark			
		Al	Cu	Fe	Sn	Al	Cu	Fe	Sn
0.1	ΔL*	-14.75	-19.76	-40.63	-18.80	-13.20	-14.67	-22.50	-20.63
	Δa*	1.03	8.71	3.16	4.40	6.41	6.40	3.60	11.44
	Δb*	25.56	18.61	5.24	25.70	16.35	13.50	9.91	20.79
	K/S	3.5576	1.3801	3.8181	5.3280	0.8739	0.7289	1.0990	2.1850
0.5	ΔL*	-14.75	-19.10	-41.09	-17.37	-13.51	-15.15	-22.94	-21.20
	Δa*	1.03	8.38	2.94	3.70	6.58	6.69	3.56	11.32
	Δb*	25.56	18.26	5.24	25.30	16.31	13.87	8.85	21.12
	K/S	3.5576	1.3287	3.3890	5.1195	0.861	0.7486	1.0034	2.3060
1.0	ΔL*	-15.12	-18.39	-41.55	-17.40	-13.85	-15.58	-24.90	-22.94
	Δa*	0.95	7.44	3.20	3.71	6.69	6.26	3.53	11.40
	Δb*	25.46	17.89	5.29	25.32	15.69	13.70	8.52	21.18
	K/S	3.6301	1.3179	3.5818	5.1201	0.8803	0.7056	1.095	2.3262
1.5	ΔL*	-13.81	-13.96	-41.00	-18.94	-13.50	-14.66	-24.61	-22.88
	Δa*	0.69	2.68	2.90	4.38	6.55	6.41	3.50	11.96
	Δb*	25.38	20.21	5.20	26.24	15.71	13.98	8.60	21.10
	K/S	3.5046	1.2789	3.3701	5.6772	0.8178	0.7421	1.0912	2.4616
2.0	ΔL*	-15.11	-13.78	-43.18	-18.89	-13.46	-14.67	-24.13	-22.80
	Δa*	0.98	2.69	3.21	4.46	6.57	6.40	3.51	11.90
	Δb*	25.44	20.09	5.06	25.77	16.16	13.53	8.20	21.10
	K/S	3.6299	1.2800	3.9072	5.3386	0.8202	0.7289	1.0517	2.4016

Remark: K/S (λ= 400 nm)

From Tables 4.12 and 4.13, it is showed that the quantity of mordant compound at 0.1% - 2.0% owf. gained the approximate result of K/S value in each mordant compound. The result is illustrated in Figure 4.19 to Figure 4.21.

From the experiment result, a condition of pre-mordant treated with varying quantity of mordant compound showed that the increasing quantity of mordant cannot increase dye absorption.

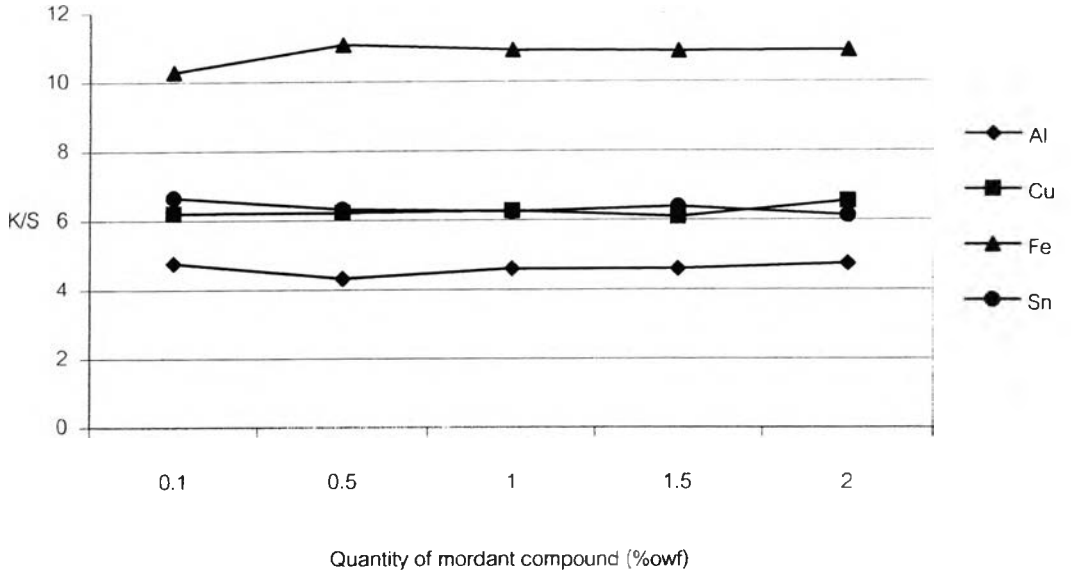

Figure 4.19 K/S value for dyed silk from eucalyptus leaves by varying quantity of mordant compound

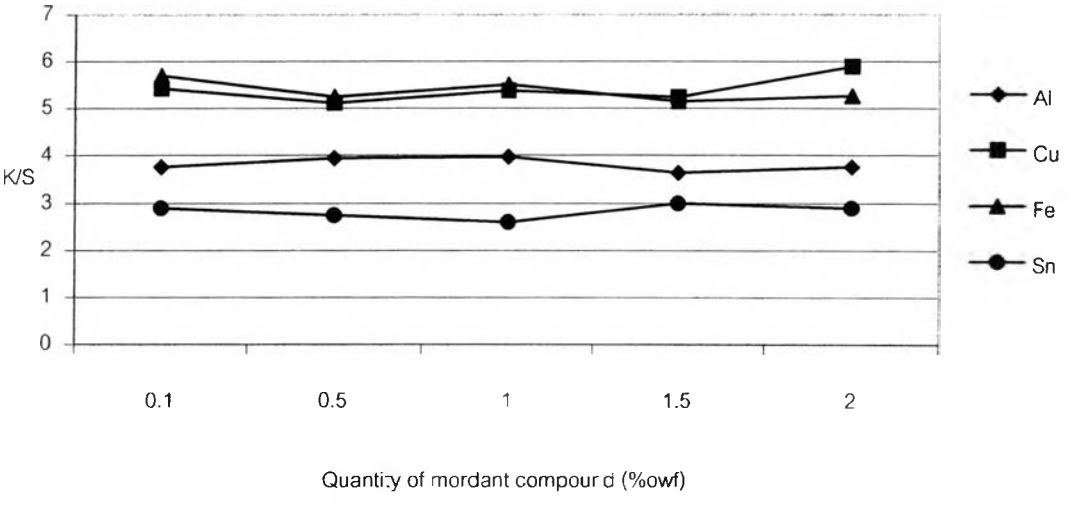

Figure 4.20 K/S value for dyed silk from eucalyptus bark by varying quantity of mordant compound

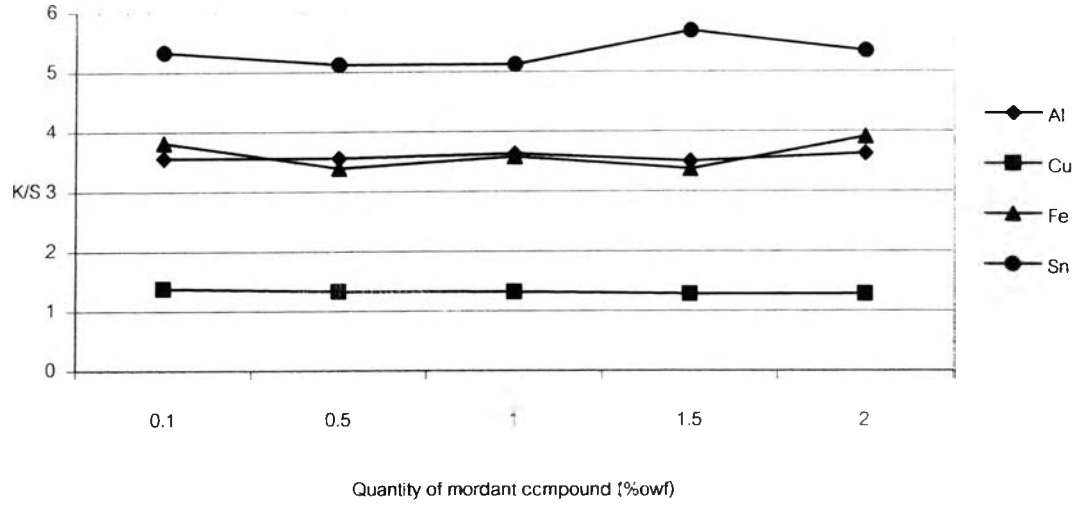

Figure 4.21 K/S value for dyed cotton from eucalyptus leaves by varying quantity of mordant compound

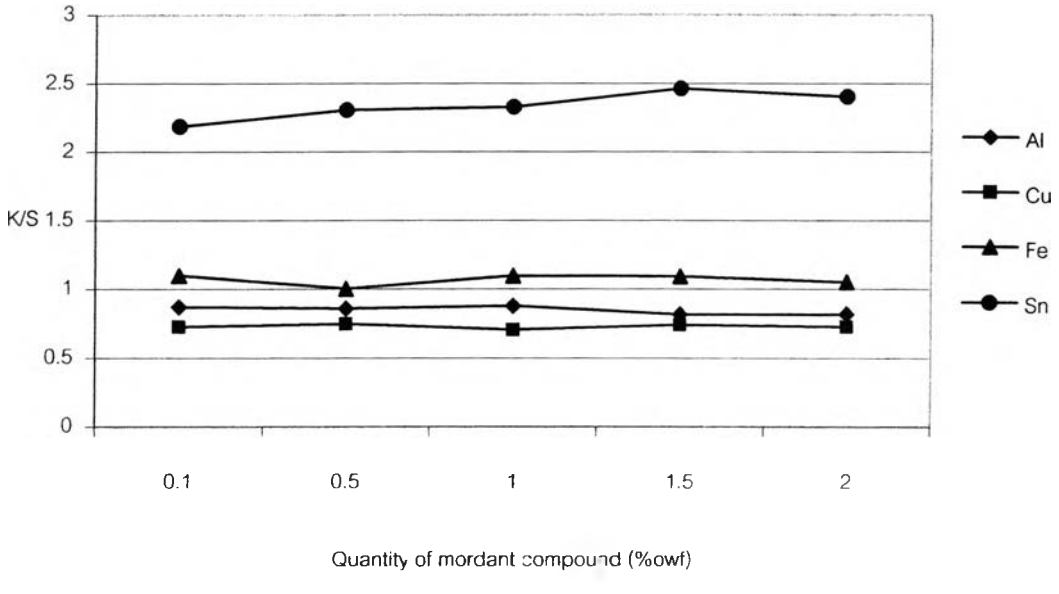

Figure 4.22 K/S value for dyed cotton from eucalyptus bark by varying quantity of mordant compound

4.4 Appropriate condition for silk and cotton dyeing

The 3.3.4 experiment is to find the suitable condition for pre-mordant process and for dyeing process of cotton and silk fabric. The results are shown in Table 4.14

Table 4.14 The ΔL* , Δa* , Δb* and K/S value for suitable condition of pre-mordanting and dyieng of silk and cotton fabrics

Type of mordant compound	Pre-mordant on silk fabric							
	Colour measurement D65/ 10°							
	Dye sclution from							
	Eucalyptus leaves				Eucalyptus bark			
	ΔL*	Δa*	Δb*	K/S	ΔL*	Δa*	Δb*	K/S
No mordant	-37.09	6.60	23.01	7.0272	-43.35	15.68	18.73	5.8372
Al	-27.03	4.79	29.06	6.6969	-36.39	12.34	21.94	5.7061
Cu	-38.97	7.61	24.41	7.238'	-38.68	8.00	21.35	6.4992
Fe	-68.85	1.57	0.22	15.532	-48.55	3.98	9.18	7.1239
Sn	-18.05	4.06	34.60	6.1253	-23.48	9.09	22.22	3.6380
Type of mordant compound	Pre-mordant on cotton fabric							
	Colour measurement D65/ 10°							
	Dye solution from							
	Eucalyptus leaves				Eucalyptus bark			
	ΔL*	Δa*	Δb*	K/S	ΔL*	Δa*	Δb*	K/S
No mordant	-8.95	1.10	16.15	1.0334	-16.33	9.85	19.12	1.0618
Al	-14.11	1.13	30.75	4.5146	-14.66	6.86	19.10	1.3222
Cu	-18.36	3.39	26.67	3.4372	-20.27	8.70	18.79	1.5357
Fe	-55.30	5.73	11.52	9.6543	-27.23	4.91	11.13	1.6502
Sn	-26.57	4.05	30.94	4.5044	-25.94	5.75	28.12	4.4001

Remark: K/S (λ= 400 nm)

Pre-mordanting with mordant compounds before dyeing as shown in Table 4.14, by adjusting pH of dye solution as mentioned in item 3.3.4 of procedure. The ratio of absorption will be increased. (See the value of K/S in Figure 4.23 and Figure 4.24.)

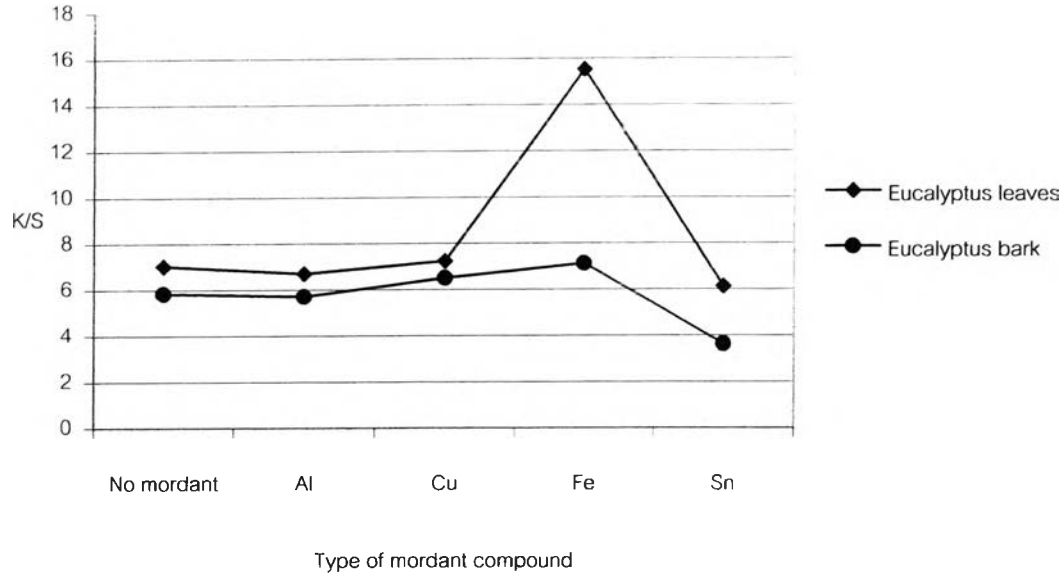

Figure 4.23 K/S value for suitable condition of pre-mordanting and dyeing on silk fabric

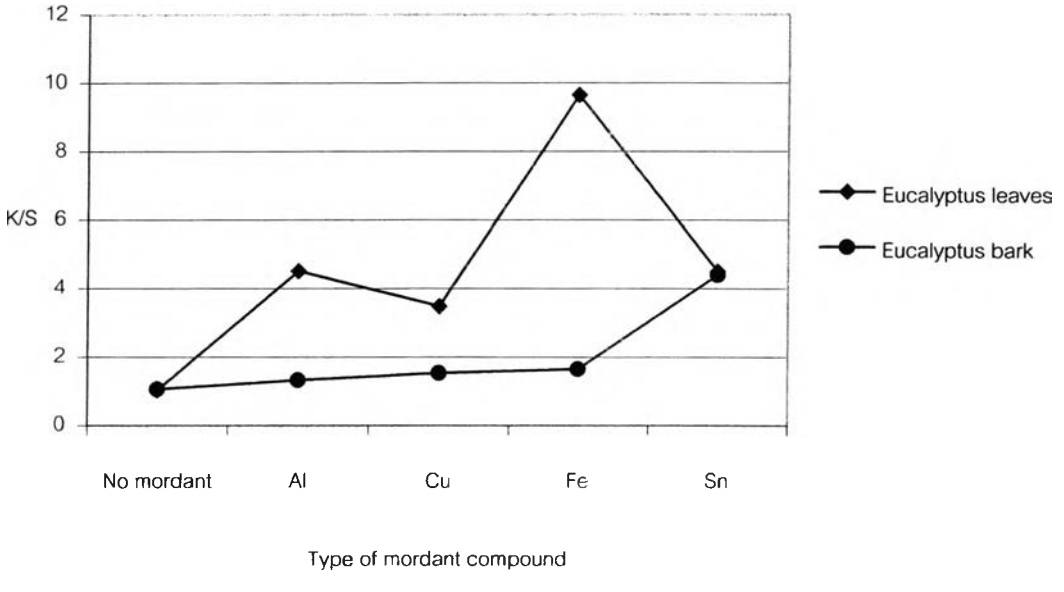

Figure 4.24 K/S value for suitable condition of pre-mordanting and dyeing on cotton fabric

Silk and cotton are treated in pre-mordanting process before dyeing in the suitable condition as seen below

Figure 4.25 Silk is untreated with pre-mordanting process before dyeing in the solution from eucalyptus leaves

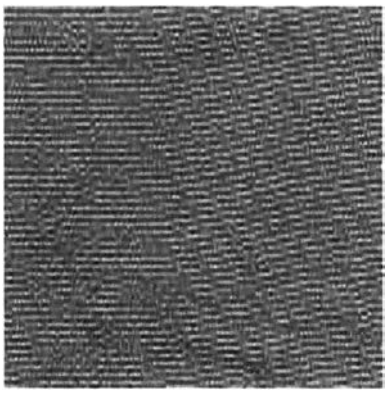

Figure 4.26 Silk is untreated with pre-mordanting process before dyeing in the solution from eucalyptus bark

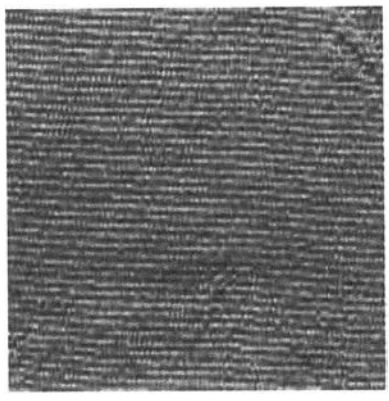

Figure 4.27 Silk is treated with pre-mordanting process using the aluminium mordant before dyeing the solution from eucalyptus leaves

Figure 4.28 Silk is treated with pre-mordanting process using the aluminium mordant before dyeing in the solution from eucalyptus bark

Figure 4.29 Silk is treated with pre-mordanting process using the copper mordant before dyeing the solution from eucalyptus leaves

Figure 4.30 Silk is treated with pre-mordanting process using the copper mordant before dyeing the solution from eucalyptus bark

Figure 4.31 Silk is treated with pre-mordanting process using the ferrous mordant before dyeing the solution from eucalyptus leaves

Figure 4.32 Silk is treated with pre-mordanting process using the ferrous mordant before dyeing the solution from eucalyptus bark

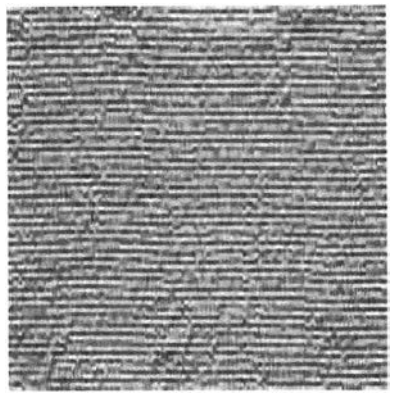

Figure 4.33 Silk is treated with pre-mordanting process using the stannous mordant before dyeing the solution from eucalyptus leaves

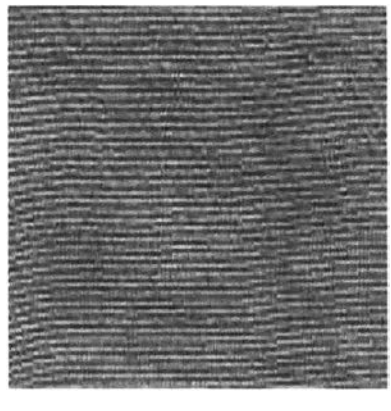

Figure 4.34 Silk is treated with pre-mordanting process using the stannous mordant before dyeing the solution from eucalyptus bark

Figure 4.35 Cotton is untreated with pre-mordanting process before dyeing in the solution from eucalyptus leaves

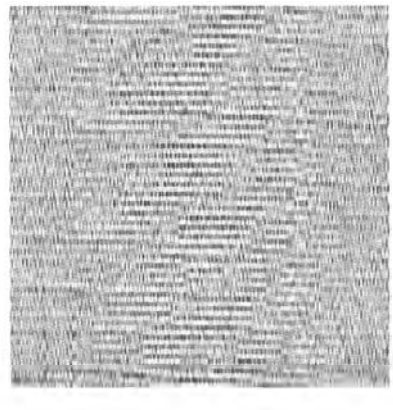

Figure 4.36 Cotton is untreated with pre-mordanting process before dyeing in the solution from eucalyptus bark

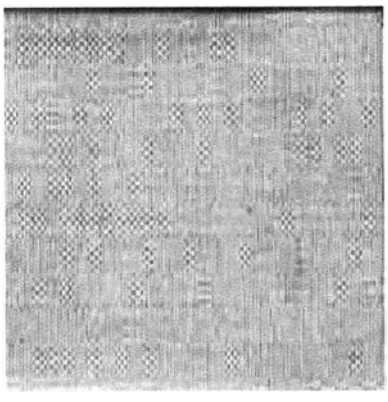

Figure 4.37 Cotton is treated with pre-mordanting process using the aluminium mordant before dyeing the solution from eucalyptus leaves

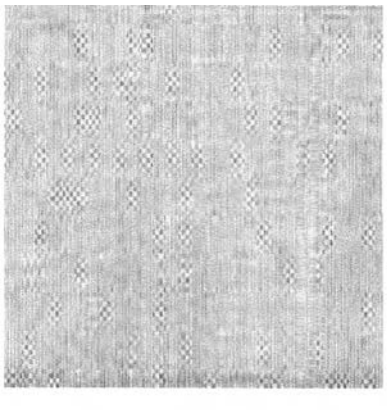

Figure 4.38 Cotton is treated with pre-mordanting process using the aluminium mordant before dyeing the solution from eucalyptus bark

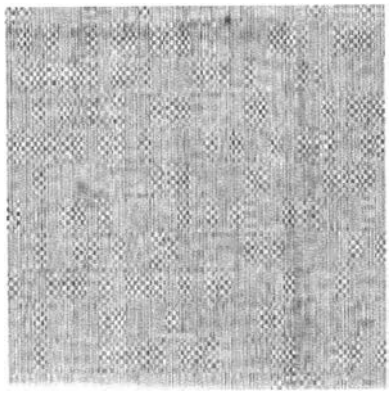

Figure 4.39 Cotton is treated with pre-mordanting process using the copper mordant before dyeing the solution from eucalyptus leaves

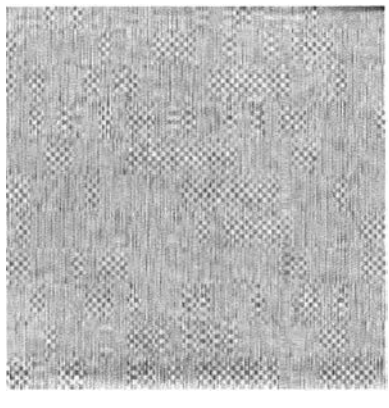

Figure 4.40 Cotton is treated with pre-mordanting process using the copper mordant before dyeing the solution from eucalyptus bark

Figure 4.41 Cotton is treated with pre-mordanting process using the ferrous mordant before dyeing the solution from eucalyptus leaves

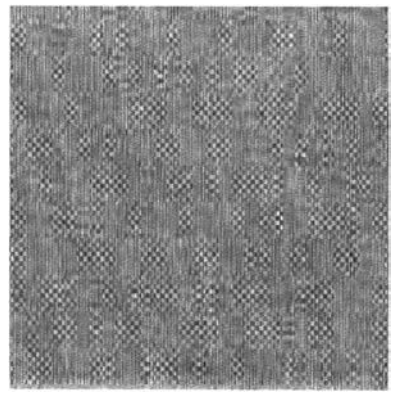

Figure 4.42 Cotton is treated with pre-mordanting process using the ferrous mordant before dyeing the solution from eucalyptus bark

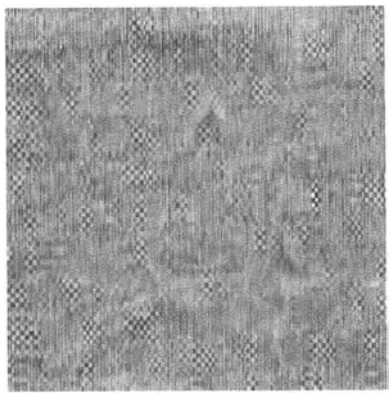

Figure 4.43 Cotton is treated with pre-mordanting process using the stannous mordant before dyeing the solution from eucalyptus leaves

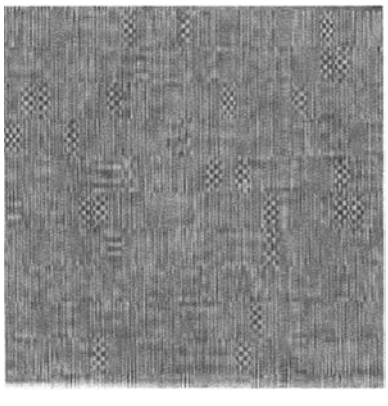

Figure 4.44 Cotton is treated with pre-mordanting process using the stannous mordant before dyeing the solution from eucalyptus bark

4.5 The results of colour fastness test

From the experiment of 3.3.5.2 – 3.3.5.6 the colour fastness properties are illustrated as following

4.5.1 Colour fastness to light

From the experiment, silk treated with pre-mordanting process before dyeing in the solution from eucalyptus leaves has the property of colour fastness to light in range 5 but dyeing in the solution from eucalyptus bark has in range of 4 – 5.

Cotton treated with pre-mordanting process before dyeing in the solution from eucalyptus leaves, the property of colour fastness to light was in range 4, dyeing in the solution from eucalyptus bark was in range of 3 as shown in Table 4.15.

Table 4.15 The result of colour fastness to light (Standard: ISO 105-B02: 1994)

Dyeing description	Colour change
1. Dyed on silk fabric from eucalyptus leaves	
1.1 No mordant	5
1.2 Al mordant	5
1.3 Cu mordant	5
1.4 Fe mordant	5
1.5 Sn mordant	5
2. Dyed on silk fabric from eucalyptus bark	
2.1 No mordant	4-5
2.2 Al mordant	4-5
2.3 Cu mordant	4-5
2.4 Fe mordant	4-5
2.5 Sn mordant	4-5

Table 4.15 The result of colour fastness to light (Standard: ISO 105-B02: 1994)

(continue)

Dyeing description	Colour change
3. Dyed on cotton fabric from eucalyptus leaves	
3.1 No mordant	4
3.2 Al mordant	4
3.3 Cu mordant	4
3.4 Fe mordant	4
3.5 Sn mordant	4
4. Dyed on cotton fabric from eucalyptus bark	
4.1 No mordant	3
4.2 Al mordant	3
4.3 Cu mordant	3
4.4 Fe mordant	3
4.5 Sn mordant	3

The following experiment illustrated the difference between silk treated with pre-mordanting process before dyeing in the solution from eucalyptus leaves and eucalyptus bark, showed very good in colour fastness to light. While cotton dyed with the solution of eucalyptus leaves was very good in colour fastness to light but fair if dyed with the solution of eucalyptus bark

4.5.2 Colour fastness to washing

From the experiment, silk treated with pre-mordanting process before dyeing in the solution from the eucalyptus leaves and bark, showed colour change in range 4 to 4 – 5 and colour staining in range 4 – 5. Both the change of colour and the degree of staining are very good.

The cotton dyed with the solution from eucalyptus leaves and bark, showed the colour change in range 3 – 4 to 4 and colour staining in range 4 – 5 as seen in Table 4.16.

Table 4.16 The result of colour fastness to washing

(Standard: ISO 105-CO6 A1S: 1994)

Dyeing description	Colour change	Colour staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1. Dyed on silk fabric from eucalyptus leaves							
1.1 No mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.2 Al mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.3 Cu mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
1.4 Fe mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.5 Sn mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
2. Dyed on silk fabric from eucalyptus bark							
2.1 No mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.2 Al mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.3 Cu mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
2.4 Fe mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.5 Sn mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
3. Dyed on cotton fabric from eucalyptus leaves							
3.1 No mordant	3-4	4-5	4-5	4-5	4-5	4-5	4-5
3.2 Al mordant	3-4	4-5	4-5	4-5	4-5	4-5	4-5
3.3 Cu mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
3.4 Fe mordant	3-4	4-5	4-5	4-5	4-5	4-5	4-5
3.5 Sn mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4. Dyed on cotton fabric from eucalyptus bark							
4.1 No mordant	3-4	4-5	4-5	4-5	4-5	4-5	4-5
4.2 Al mordant	3-4	4-5	4-5	4-5	4-5	4-5	4-5
4.3 Cu mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4.4 Fe mordant	3-4	4-5	4-5	4-5	4-5	4-5	4-5
4.5 Sn mordant	4	4-5	4-5	4-5	4-5	4-5	4-5

4.5.3 Colour fastness to water

From the experiment, silk and cotton dyed with the solution from eucalyptus leaves and bark, showed colour fastness to water in range of 4 to 4-5 as seen in Table 4.17.

Table 4.17 The result of colour fastness to water (Standard: ISO 105-EO1: 1994)

Dyeing description	Colour change	Colour staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	wool
1. Dyed on silk fabric from eucalyptus leaves							
1.1 No mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.2 Al mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.3 Cu mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.4 Fe mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.5 Sn mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2. Dyed on silk fabric from eucalyptus bark							
2.1 No mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.2 Al mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.3 Cu mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.4 Fe mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.5 Sn mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
3. Dyed on cotton fabric from eucalyptus leaves							
3.1 No mordant	4	4-5	4	4	4-5	4-5	4-5
3.2 Al mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
3.3 Cu mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
3.4 Fe mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
3.5 Sn mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
4. Dyed on cotton fabric from eucalyptus bark							
4.1 No mordant	4	4-5	4	4-5	4	4	4
4.2 Al mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4.3 Cu mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
4.4 Fe mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
4.5 Sn mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5

4.5.4 Colour fastness to perspiration

Silk and cotton treated with pre-mordanting process before dyeing in the solution from eucalyptus leaves and bark, showed colour fastness to perspiration are in range 4 to 4 – 5. For colour change and color staining can be seen in Table 4.18 and Table 4.19.

Table 4.18 The result of colour fastness to perspiration (acid)

(Standard: ISO 105-EO4: 1994)

Dyeing description	Colour change	Colour staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
1. Dyed on silk fabric from eucalyptus leaves							
1.1 No mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.2 Al mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.3 Cu mordant	4-5	4-5	4	4	4	4	4
1.4 Fe mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
1.5 Sn mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
2. Dyed on silk fabric from eucalyptus bark							
2.1 No mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.2 Al mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.3 Cu mordant	4-5	4-5	4	4-5	4-5	4-5	4-5
2.4 Fe mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
2.5 Sn mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
3. Dyed on cotton fabric from eucalyptus leaves							
3.1 No mordant	4	4-5	4	4	4-5	4-5	4
3.2 Al mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
3.3 Cu mordant	4	4-5	4	4	4-5	4-5	4-5
3.4 Fe mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
3.5 Sn mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4. Dyed on cotton fabric from eucalyptus bark							
4.1 No mordant	4	4-5	4-5	4	4-5	4-5	4
4.2 Al mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
4.3 Cu mordant	4	4-5	4	4-5	4	4-5	4-5
4.4 Fe mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4.5 Sn mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5

Table 4.19 The result of colour fastness to perspiration (alkaline)

(Standard: ISO105-EO4: 1994)

Dyeing description	Colour change	Colour staining					
		Acetate	Cotton	Nylon	Polyester	Acrylic	wool
1. Dyed on silk fabric from eucalyptus leaves							
1.1 No mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
1.2 Al mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
1.3 Cu mordant	4-5	4	4	4	4	4	4
1.4 Fe mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
1.5 Sn mordant	4	4	4-5	4-5	4-5	4-5	4-5
2. Dyed on silk fabric from eucalyptus bark							
2.1 No mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
2.2 Al mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
2.3 Cu mordant	4-5	4	4	4	4	4	4
2.4 Fe mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
2.5 Sn mordant	4-5	4-5	4-5	4-5	4-5	4-5	4-5
3. Dyed on cotton fabric from eucalyptus leaves							
3.1 No mordant	4	4-5	4	4-5	4-5	4-5	4
3.2 Al mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
3.3 Cu mordant	4	4-5	4	4-5	4-5	4-5	4-5
3.4 Fe mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
3.5 Sn mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4. Dyed on cotton fabric from eucalyptus bark							
4.1 No mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4.2 Al mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4.3 Cu mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4.4 Fe mordant	4	4-5	4-5	4-5	4-5	4-5	4-5
4.5 Sn mordant	4	4-5	4-5	4-5	4-5	4-5	4-5

4.5.5 Colour fastness to rubbing

From the experiment, silk treated with pre-mordanting process before dyeing in the solution from eucalyptus leaves and bark, colour fastness to rubbing showed in range of 3 – 4 to 4 (fair – good) and 4 to 4 – 5 (good – very good) for cotton, as seen in Table 4.20.

Table 4.20 The result of colour fastness to rubbing

(Standard: ISO105-X12: 2001)

Dyeing description	Colour staining			
	Warp direction		Weft direction	
	Dry	Wet	Dry	Wet
1. Dyed on silk fabric from eucalyptus leaves				
1.1 No mordant	4	3-4	4	3-4
1.2 Al mordant	3-4	3	3-4	3
1.3 Cu mordant	3-4	3	3-4	3
1.4 Fe mordant	3-4	3	3-4	3
1.5 Sn mordant	3-4	3	3-4	3
2. Dyed on silk fabric from eucalyptus bark				
2.1 No mordant	4	3-4	4	3-4
2.2 Al mordant	3-4	3	3-4	3
2.3 Cu mordant	3-4	3	3-4	3
2.4 Fe mordant	3-4	3	3-4	3
2.5 Sn mordant	3-4	3	3-4	3
3. Dyed on cotton fabric from eucalyptus leaves				
3.1 No mordant	4-5	4-5	4-5	4-5
3.2 Al mordant	4-5	4	4-5	4
3.3 Cu mordant	4-5	4	4-5	4
3.4 Fe mordant	4-5	4	4-5	4
3.5 Sn mordant	4-5	4	4-5	4
4. Dyed on cotton fabric from eucalyptus bark				
4.1 No mordant	4-5	4-5	4-5	4-5
4.2 Al mordant	4-5	4	4-5	4
4.3 Cu mordant	4-5	4	4-5	4
4.4 Fe mordant	4-5	4	4-5	4
4.5 Sn mordant	4-5	4	4-5	4