Study of Low Stress Mechanical Properties of Silk and Bamboo Knitted Fabrics Dyed with Cannon Ball Fruit Extract

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***Abstract* - Natural dyes as compared to synthetic dyes have better biodegradability, nontoxic and have higher compatibility with the environment. In the present study Cannon ball fruit is used as the dye source. The present paper discusses on low stress mechanical properties of silk and bamboo knitted fabrics with addition of lycra. The Kawabata evaluation system was used to measure the low stress mechanical properties of dyed fabrics . The study reveals that the handle properties of Silk and Bamboo Knitted fabrics dyed with Cannon ball fruit extract are significantly influenced.**

Keywords - Knitted Fabrics, Cannon Ball Fruit , Total Hand Value

INTRODUCTION

Dyeing is one of the most ancient ways of decorating fabric. Natural dyes as compared to synthetic dyes have better biodegradability, nontoxic and have higher compatibility with the environment. Natural dyes are considered as very good for their colour experimentation quality[1]. In the present study Cannon ball fruit is used as the dye source.

The study aimed at not only establishing extraction and standardization of dye from Cannon ball fruit but also determining the low stress mechanical properties of silk and bamboo fabrics dyed with Cannon ball fruit extract.

Cannon ball fruit pulp is a good source of indigo dye[2] The present paper discusses on low stress mechanical properties of Silk and Bamboo fabrics with addition of lycra. The Kawabata evaluation system was used to measure the low stress mechanical properties of samples treated with Cannon ball fruit pulp . Various parameters such as tensile , bending, shearing, surface, compression, total hand values were measured and found that the dyeing of fabrics using Cannon ball fruit has significantly influenced the handle properties of Silk and Bamboo knitted fabrics.

MATERIALS AND METHODS

Commercially available 100 % bamboo and 100% silk were sourced from Tirupur, India. It was ensured that all of the yarns purchased had the same mean linear density of 40^s Ne_c. The above yarns were used to produce single jersey fabrics Meyer and Cie knitting machines of the following details: Single jersey machine, model MV4, gauge 32 GG, diameter 36”, speed 25 rpm, feeders 74 and number of needles 2640; the ambient knitting-room atmosphere had a humidity of 65% and a temperature of 30 ± 2°C. Samples were produced with same loop-length value of 2.5 mm fabrics respectively. The knitting process was completed with constant machine settings and the samples were kept in standard atmosphere for 24 hours to allow for relaxation and conditioning.

Dyeing

The fabrics were wetted and padded using padding mangle which contained the extracted dye (150ml) and mordant (10% - Alum and Pomegranate rind) . pH of the dye extract was 7-9. The speed of the padding mangle was maintained 25 rpm and pressure being 20 – kgf /cm^2 . The padded fabrics were taken out after 30 minutes and cured at 45 ^{o} C for about 10minutes.

The above dyed fabrics were tested for low stress mechanical properties.

Low stress mechanical properties

The Kawabata evaluation system fabrics (KESF) was used for measuring the low stress mechanical properties like tensile, shearing, bending, surface and compression of fabrics dyed with of the Cannon ball fruit extract. The low stress mechanical properties of 100% knitted (both silk and bamboo) fabrics were compared with that of alum mordanted dyed (both silk and bamboo)and pomegranate mordanted (both silk and bamboo)lycra fabrics using KESF system were determined.

RESULTS AND DISCUSSION

Low stress mechanical properties of Silk and Bamboo controlled as well as dyed fabrics were determined under a standard condition.

Table I shows the mean value of low stress mechanical properties of controlled and dyed knitted silk and bamboo fabrics.

Tensile Properties

Figure I represents the percentage extension at maximum applied load of 500 gf/cm specimen width .

TABLE I

KESF DATA	S	SA	SLP	B	BA	BLP
Bending						
B(gf.cm^2/cm)	0.0115	0.0111	0.0175	0.0210	0.0085	0.0081
2HB(gf.cm/cm)	0.0112	0.0095	0.0093	0.0329	0.0082	0.0083
2HB/B	0.973	0.855	0.53	1.566	0.964	1.02
Tensile						
LT	0.703	0.685	0.750	0.849	0.712	0.659
WT(gf.cm/cm^2)	3.24	2.31	4.43	2.022	2.11	2.43
RT(%)	46.29	42.31	42.56	36.42	49.98	50.92
EMT(%)	24.33	34.60	36.03	13.47	18.25	23.65
Shear						
G(gf/cm.deg)	0.47	0.54	0.52	0.72	0.58	0.59
2HG(gf/cm)	1.93	2.68	1.96	4.57	3.09	2.71
2HG5(gf/cm)	1.87	2.42	1.94	4.23	2.97	2.33
Compression						
LC	0.495	0.510	0.532	0.589	0.535	0.535
WC(g.cm/cm^2)	0.058	0.056	0.095	0.094	0.064	0.077
RC(%)	40.69	37.09	35.87	33.89	36.44	36.58
T_0(mm)	0.652	0.640	0.875	0.821	0.698	0.753
T_M(mm)	0.415	0.414	0.516	0.500	0.458	0.458
Compression %	36	35	41	39	34	39
Surface						
MIU	0.193	0.230	0.236	0.190	0.245	0.208
MMD	0.0168	0.0158	0.0117	0.0105	0.0146	0.0102
SMD(μm)	4.957	5.327	3.875	5.149	3.520	3.790
Fabric wt.(mg/cm^2)	10.93	11.17	11.98	12.75	13.54	13.91
THV	2.98	3.17	3.28	3.14	3.38	3.37
Specific Vol	5.9	5.7	7.3	6.4	5.1	5.4

Note

1. S- 100% Silk , SA- Silk Alum mordanted , SLP - Silk Lycra Pomegranate mordanted
2. B- 100% Bamboo, BA- Bamboo Alum mordanted BLP-Bamboo Lycra Pomegranate mordanted.

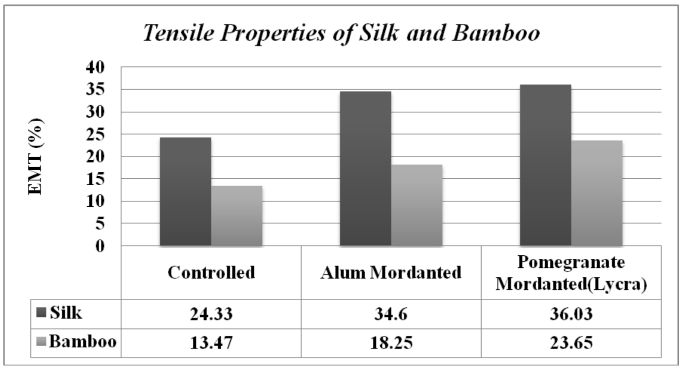

Fig. I

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 06, June-2018

Tensile properties such as LT, WT, RT and EMT which have been measured using Kawabata evaluation system showed considerable variation for silk and bamboo fabrics. LT represents linearity of load extension and if a value of 1 is obtained it indicates perfect elasticity . The values of silk are generally higher in comparison to bamboo fabrics , WT and RT are interrelated, silk fabrics showed a lower value of elongation and bamboo fabrics showed higher elongation. In particular the fabrics containing lycra and dyed with pomegranate mordant showed significantly a higher value which is due to lycra filament . RT and EMT also were interrelated. The larger the value of EMT the greater will be the wearer comfort[3]. It is evident from Figure- I that the EMT values of both silk and bamboo fabrics dyed with Cannon ball fruit extract has increased in comparison with controlled fabrics thereby increasing the wearers comfort.

Bending Properties

Bending rigidity is a measure which determines how easily a fabric can bend. Bending properties namely B and 2HB are very important as they affect drape and handle of fabrics.

Figure II represents the bending properties of silk and bamboo knitted fabrics.

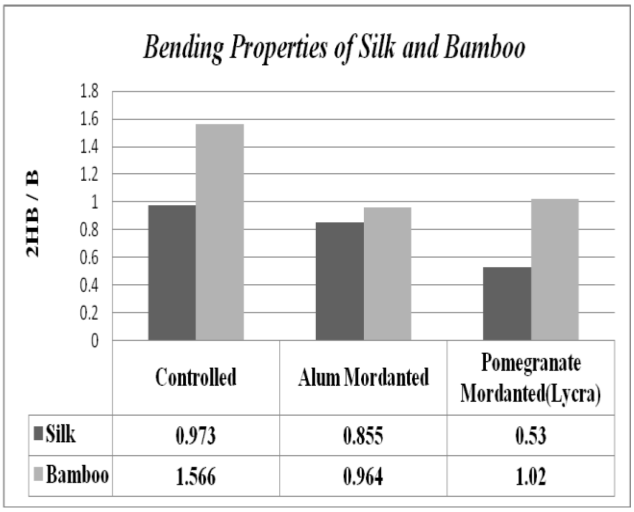

Fig. II.

It is observed from Fig.II that bamboo fabrics both in controlled and dyed state have higher bending rigidity in comparison with silk fabrics. Hysteresis of bending moment (2HB) indicates a measure of recovery from bending deformation. Lower the value of B and 2HB better is the bending rigidity and bending moment[4]. The same trend can be observed in silk and bamboo fabrics dyed with Cannon ball fruit extract in comparison with controlled fabrics which is evident from Table I.

Shear Properties

Figure III represents the shear strain properties of silk and bamboo fabrics

Shear rigidity (G) or Shear properties are important as they give an idea of shape retention characteristics of fabrics. The fabrics to have better handle the value of G should be lower. If the fabrics have higher value of G the fabrics lacks the comfort properties. It can be inferred from Figure III that shear rigidity (G) is lower for dyed fabrics (both silk and bamboo) in comparison with controlled fabrics.

As far as shear hysteresis values (2HG and 2HG5) were concerned it was noticed that bamboo fabrics were significantly higher compared to silk fabrics.

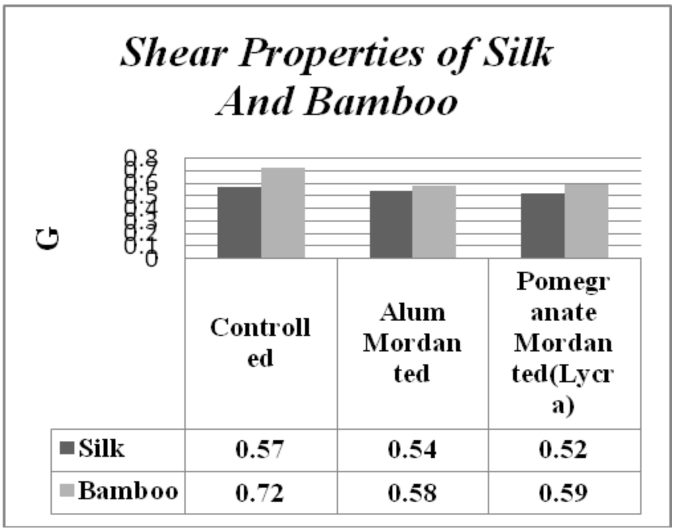

Fig. III.Compressional Properties

Figure IV shows compressional percentage of silk and bamboo fabrics.

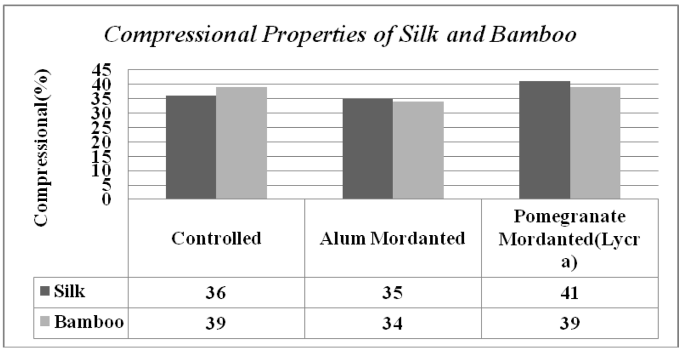

Fig.IV

LC values are found to be higher with respect to bamboo in comparison to silk fabrics. WC represents compressional energy and are considered to be important as a higher value of WC indicates fluffy nature. It is evident from Table -I that silk is more compressible than that of bamboo fabrics. This is also reflected in the percentage compression. In general the percentage compression of bamboo fabrics are found to be higher than that of silk fabrics.

Surface characteristics

The values of coefficient of friction of silk and bamboo fabrics were found to be significantly different. Surface roughness of silk fabrics after dyeing and after inclusion of lycra are different and showed increase in comparison to the untreated controlled fabrics.

Total Hand Values(THV)

Figure V represents the total hand values of silk and bamboo fabrics.

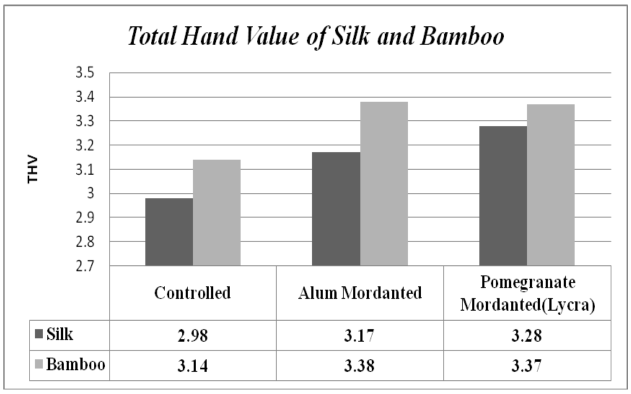

Fig.V.

It is noticed that the THV values of bamboo fabrics are slightly higher than that of silk fabrics. Total hand values has improved for both silk and bamboo fabrics after_it was alum mordanted dyed and lycra included pomegranate mordanted dyed fabrics.

CONCLUSION

The handle properties play an important role in comfort properties and is definitely influenced by dyeing using Cannon ball fruit extract and with inclusion of lycra. The tensile strength, EMT values of both silk and bamboo fabrics dyed with Cannon ball fruit extract has increased in comparison with controlled fabrics thereby increasing the wearers comfort. The bending rigidity of bamboo fabrics both in controlled and dyed state have higher values in comparison with silk fabrics. Though the shear rigidity (G) is lower for dyed fabrics (both silk and bamboo) in comparison with controlled fabrics the shear hysteresis values (2HG and 2HG5) of bamboo fabrics were significantly higher compared to silk fabrics. It was noticed that the percentage compression of bamboo fabrics are found to be higher than that of silk fabrics. It was also observed that the total hand values has improved for both silk and bamboo fabrics after_it was alum mordanted dyed and lycra included pomegranate mordanted dyed fabrics.

Hence it can be concluded that hand value of fabrics dyed with Cannon ball fruit extract showed better handle properties which is evident from the objective evaluation using Kawabata evaluation system.

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