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ORIGINAL ARTICLE

A COMPARATIVE STUDY ON THE CHARACTERISTIC PROPERTIES OF ERI AND TUSSAR SILK AFTER DYEING

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Abstract:

The main purpose of this study was to degum, bleach and dye raw Eri silk and raw Tussar silk with acid dyes and compare the characteristic properties such as geometric, durability and comfort properties of eri silk and Tussar silk. The geometric properties were also assessed like the fabric count, fabric weight and fabric thickness. The tests to evaluate the durability and comfort properties were done by subjecting the samples to breaking strength, abrasion resistance, elongation, wicking, bending length, flexural rigidity, crease recovery and drapability. In the case of fabric count, fabric weight and fabric thickness, there was an increase in the values of the dyed samples than the control samples. It was found that Eri silk showed good performance with respect to breaking strength, abrasion resistance, elongation, wicking, bending length, flexural rigidity, crease recovery and drapability thus proving better to durability and comfort properties.

INTRODUCTION:

Silk is one of the oldest fibers known to man. Silk is processed from silk worms and is considered as a mark of luxury. It has occupied an enviable place in the field of textiles and its use as textile fiber is as old as human civilization. Silk has been the "Queen of Fabrics" for centuries. Even today no other fabric can match its strength, luster, soft texture and elegance. Its graceful drape is an added advantage which makes it attractive of all textiles. The various kinds of silk that are commercially produced may include Mulberry silk, Tassar Silk, Muga Silk and Eri silk.

Eri silk is a staple fiber unlike other silks which are continuous filament. The texture of the fabric is like coarse, fine and dense. It is very strong, durable and has elasticity. Eri silk is darker and heavier than other silks and blends well with wools and cotton. Due to its thermal property it is warm in winters and cool in summer. Tassar silkworm is larger than Bombyx Mori and is both monovoltine and bivoltine. The Indian wild silk is called Tassar silk. The two varieties of Tassar are Tropical Tassar and Oak Tassar. Degumming is the process employed to remove the silk gum from he raw silk. Sericin remains on the fibers during reeling and throwing. This is not desirable as the presence of gum or sericin decreases absorption capacity. When the gum has been removed the silk fiber or fabric is a creamy white color, beautiful, lustrous and luxuriantly soft. Bleaching is a chemical finish that is performed on yarn, fiber or fabric to make them white or to prepare them for dyeing or any other finish. This process is carried out by the use of chemicals such as peroxides, Chlorine bleaching compounds or sulphurous acids. Dyeing is a process of coloring textile fibers, yarns or fabrics so that the coloring matter becomes an integral part of the fiber rather than a sulphur coating. Acid dyes can be used for silk fabrics. The dyeing process involves an associative chemical reaction where in the fiber molecules attract the acid dye and an associative bond is established.

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OBJECTIVES

To degum, bleach and dye raw Eri and Tussar silk fabrics with acid dyes.
To determine the geometric parameters such as fabric count, fabric thickness and fabric weight after dyeing.
To evaluate the durability of eri silk and tussar silk with the help of tests such as tensile strength and abrasion resistance after dyeing.
To study the comfort properties of eri silk and tussar silk by conducting elongation at break, wicking, bending length, flexural rigidity, crease recovery and drapability tests after dyeing.

METHODOLOGY

The main purpose of the study is to compare the color fastness properties of Eri and Tassar silk fabric after dyeing.

SELECTION AND PREPARATION OF FABRIC

The fabric selected for the study was Eri and Tussar silk. One meter of Eri Silk Tussar silk each was bought from Bihar, through handloom expo in Valluvarkottam, Chennai. A small piece of fabric from both Eri and Tussar silk was cut as control sample.

DEGUMMING

Requirements

Weight of the fabric
Water required =M: L ratio =1:30
Sol bar soap -10%, Soda ash – 10 %
Temperature =100oC
Duration - 30 to 40 minutes.

The water bath was heated with 10% of bar soap and 10% of soda ash and heated to boiling point. Then the fabric was immersed and allowed to agitate for a period of 30 to 40 minutes. The fabric was worked every 10 minutes for standard output.

BLEACHING

Oxidation bleaching was selected for the study.

HYDROGEN PEROXIDE BLEACH

Requirements
Weight of the fabric
Hydrogen peroxide: 15cc/liter
Stabilizer: 7.5g/liter
Water required - 1:30 ratio
Temperature -80oC
Duration -40 minutes.

Bleaching was carried out by taking the required amount of magnesium chloride, Sodium silicate, hydrogen peroxide and distilled water. The bath was stirred thoroughly, the material was entered and the temperature was raised slowly to 100o C and it was maintained throughout. The material was kept working throughout the entire period of bleaching. Finally the material was removed, washed thoroughly with four changes of tap water and dried at room temperature. Wash thrice in cold water and then take the fabric for dyeing.

SELECTION OF DYE- COLOR AND SHADE

Silk being protein fiber is dyed by acid dyes.The investigator chose 0.8% Nitocid violet 3B with a

combination of 0.4% Sandosilk Bordeaux.

DYEING OF SILK FABRICS

Requirements

Weight of the fabric
0.8%Nitocid Violet 3B
0.4% Sandosilk Bordeaux
Water required
Temperature =60oC.

Take both Dyestuffs, add hot water paste, and then add hot water. Boil for few minutes. Then prepare the dye bath with required quantity hot water (60oC) to which, add the above dissolved dye and Stir well. Then enter the silk material, dye for 5 minutes. Then the dye bath over a stove and continue the dyeing for further 20 to 30 minutes. Then lift the material, add 3% acetic acid to the same dye bath and put the material and dye for another 10 minutes. Then remove, wash well, squeeze and dry in shade.

TEST FOR GEOMETRIC PROPERTIES

FABRIC COUNT

Fabric count denotes the number of ends and picks per cm in the fabric. The fabric count was determined by raveling method. Five samples of size one and quarter inch square was taken. The warp and weft directions were marked and yarns were raveled out on four sides, so as to get an exact one inch square sample. The warp and filling yarns of the one inch square sample was then raveled out and counted separately. The averages of five readings were taken. The count of fabric is expressed as ends per cm and picks per cm.

FABRIC THICKNESS

The fabric thickness was determined by using Mercer's Thickness Guage. The sample was placed on the anvil and the presser foot lowered onto the samples by releasing the lever slowly. The dial reading was noted and the thickness was calculated under a constant load of 50 grams. The thickness was measured at different places and the average was calculated and expressed in millimeters. Fabric thickness in millimeter = the dial value x 0.01.

FABRIC WEIGHT

Fabric weight is the weight per square meter of woven fabric. The samples for this test were cut in the dimensions of fiver by five centimeter square fabric. The five samples cut were individually weighted in electronic balance and the average weight was taken. Weight per square meter was then calculated and expressed as grams per square meter.

TEST FOR DURABILITY PROPERTY

ABRASION RESISTANCE

Abrasion resistance was determined by Martindale's Wear Tester. The specimens were cut by means of a template into circular samples. Each sample was weighed accurately in an Electronic Balance and placed on the specimen holder and mounted by fixing the ring clamp over the sample. The number of revolutions needed for abrading the sample was determined by pre-test. Each sample was given 50 revolutions. Then the samples were again weighed accurately to the nearest 0.001 grams. The difference between the original and the abraded sample was the loss due to abrasion. This was reported as percent loss in weight as follows.

$c=A/B\times100$

A=Loss in weight due to abrasion in grams, B=Original weight of the sample in grams,
C=Percentage loss due to abrasion

The experiment was repeated for all the five samples and the mean was calculated.

BREAKING STRENGTH

The Breaking strength of the fabric was determined by using a vertical strength tester. The total capacity of the tester was 200kgs.The test was done along the warp and weft direction along each sample. The dimension of each test specimens was six by thirty two centimeters. For warp wise testing five specimens were cut with longer direction parallel to the selvedge and parallel to the filling test for weft wise testing, taking care to include different sets of warp and weft yarns. Just before doing the experiments, about 0.05centimeters of yarns was raveled out by pulling out the yarns in the longer dimensions of the test specimens. The specimens were clamped tightly between two jaws of the tester with the longer dimension parallel to the direction of the pull. The length of the dimension parallel was set to twenty centimeters. The dial was set to "0".The machine was set in motion. The upper jaw remained stationary while the lower jaw moved downward pulling the fabric in opposite direction. The machine was operated with the fabric broke. The readings were noted down directly from the dial at the moment when the fabric got torn due to the load applied. Five readings were taken from both along warp and weft directions separately for all five specimens and mean was calculated. The results were expressed in kilograms.

TEST FOR COMFORT PROPERTIES

ELONGATION AT BREAK

The elongation of each sample was obtained simultaneously when breaking strength was recorded. The maximum length the fabric elongates before it finally breaks down was the end point. The readings were noted at this moment from the scale fixed on the Vertical Strength Tester .Five readings were taken separately for both warp and weft direction and the mean were recorded in millimeters.

CREASE RECOVERY

Crease recovery test was done on Shirley Crease Recovery Tester.The test specimen was cut from the sample. The dimensions were two inches in length and one inch in width. These specimens were drawn in the warp and weft directions of the sample. Each specimen was carefully creased by folding into half and placing it between two glass plates and a four pound weight was kept over the glass plate for one minute. After one minute, the weight was removed and the specimen was transferred to the fabric clamp on the instrument with the help of forceps and allowed to recover from crease. As it recovers, the dial of the instrument was rotated to keep the free edge of the specimen in line with both the knife-edges. After one minute, the recovery angle in degrees was read from the dial. The mean value of the crease recovery angle was calculated to the nearest degree. Five samples in each warp and weft directions were tested and their average was taken. Crease recovery angle of the fabric= Mean of warp crease recovery +Mean of weft crease recovery.

DRAPABILITY

Drapability test was done on Eureka Drape meter. Taking drape meter disc as a template the samples were cut. The same disc was used as template for the paper. Weight of the paper which had been cut accordingly to the template was taken and expressed as WD in gram. Drape meter consists of transparent glass lid which is opened and the supporting disc is pressed down to the platform level and locked at position by turning slightly in clockwise direction. The top supporting disc was taken out by unscrewing the nut. The conditioned specimen was then carefully transformed and placed over the bottom supporting.

BENDING LENGTH

Bending is a measure of stiffness of the fabric. The specimens were cut to the size of graduated bending length scale measuring 6 inches x 1 inch. Samples were cut in the warp and weft direction of the fabric. Five specimens were cut in each direction. Cantilever Bending Tester was used for this test. The specimen was placed on the platform with its end on the platform coinciding with the marking "0".The scaling of slide template with its marketing was placed on the specimen. The scale was now slided slowly until the fabric was drooped over the edge of the platform. After the dropping end of the fabric was in line with the 45o line marked on the instrument. The reading on the scale which corresponded to the "0" mark on

the side was taken as the bending length of the fabric. The bending length was found similarly for both ends on both sides of the strip giving for reading for each specimen. The mean values for bending length in warp and weft directions were then calculated. The readings were expressed in centimeter.

FLEXURAL RIGIDITY

It is measure of stiffness associated with handle. Flexural rigidity was calculated from bending length values and expressed in milligram centimeter. Flexural Rigidity was computed by substituting the value of bending length and weight in grams per square meter in the formula.

$G=Wc^3 \times 10^3$ Milligram centimeter
Where, G= Flexural Rigidity, W= Weight in grams per square centimeter (GSM), C=Bending Length in centimeter.

WICKING

Five samples of 12.5 inches x 1.5 inches were cut from both along the warp and weft directions of the fabric. The top end of the sample was marked 1.5 centimeter from the length wise edge, which was used for clamping of the fabric on a stand and one centimeter was marked at the bottom end of the sample. Now the length of the longer dimensions was set to 10 centimeter. The centimeter line drawn in the fabric at the bottom end acted both as indication of the depth of the fabric immersed in the water and as the water raising level.

The sample was hung vertically on a stand in which a way that the end was kept under tension by adding a weight of two grams and dipped in a beaker containing two percent dye solution, till the one centimeter line. A measuring tape was also fixed along with the sample on the stand to take the readings. The stopwatch was switched on immediately .The dye solution rising level was noted for 5 minutes. Five readings were taken. Five minutes was kept constant for all the samples. The test was carried along both warp and weft direction of the samples separately. The mean of 5 samples was calculated and the results were expressed in centimeters.

RESULTS AND DISCUSSION

The main purpose of the study was to compare the geometric, durability and comfort properties of Eri silk and Tussar silk fabric. The geometrical properties such as fabric count, fabric thickness and fabric weight of the samples were assessed. The durability property of the samples was assessed by subjecting them to abrasion resistance and breaking strength. The comfort property of the samples was assessed by subjecting them to elongation at break, crease recovery, drape meter, bending length, flexural rigidity and wicking.

GEOMETRIC PARAMETERS

FABRIC COUNT				
UNITS	**FABRIC**	**MEAN**	**'T' VALUE**	**' P' VALUE**
ENDS PER CM	CONTROL SAMPLE ERI SILK	89.80	1.89	0.3098
	DYED ERI SILK	90.80*		
	CONTROL SAMPLE TUSSAR SILK	82.80	3.57	0.1739
	DYED TUSSAR SILK	84.40*		
PICKS PER CM	CONTROL SAMPLE ERI SILK	59.80	1.64	0.3486
	DYED ERI SILK	61.80*		
	CONTROL SAMPLE TUSSAR SILK	80.80*	2.449	0.2468
	DYED TUSSAR SILK	78.80		

FABRIC WEIGHT				
UNITS	**FABRIC**	**MEAN**	**'T' VALUE**	**' P' VALUE**
(grams per sq.m)	CONTROL SAMPLE ERI SILK	68.00	4.811	0.1305
	DYED ERI SILK	82.40*		
	CONTROL SAMPLE TUSSAR SILK	27.20	3.578	0.1735
	DYED TUSSAR SILK	33.60*		

FABRIC COUNT

Fabric count is expressed as ends per cm and picks per cm. The control sample of Eri silk showed a fabric count of 89.80 ends per cm and 59.8 picks per cm and that of Tussar silk control sample was 82.8 ends per cm and 78.5 picks per cm.The fabric count of Eri silk fabric dyed with acid dye was found to be 90.8 ends per cm and 61.8 picks per cm. The Tussar silk dyed fabric showed the fabric count of 84.4 ends per cm and 80.8 picks per cm. There was an increase in the fabric count for both Eri and Tussar silk in both the directions.

* -Significant

FABRIC WEIGHT

The fabric weight is expressed in grams per square meter. The fabric weight of the Eri silk control

sample and Tussar silk control sample was found to be 68 and 27.20 where as the dyed sample showed more fabric weight than the control sample having the readings as 82.40 for Eri silk dyed sample and 33.60 for the dyed Tussar silk fabric.

FABRIC THICKNESS

The fabric thickness is expressed in millimeters. The thickness of the sample is given in table 3 and graphically represented in figure 3.

The thickness of the Eri silk control sample and Tussar silk control sample was found to be 0.172 and 0.900 respectively. Whereas the dyed samples showed more thickness than control sample with the readings as 0.214 for Eri silk dyed sample and 0.110 for Tussar silk dyed sample.

* -Significant

FABRIC THICKNESS				
UNITS	**FABRIC**	**MEAN**	**'T' VALUE**	**' P' VALUE**
millimeter	CONTROL SAMPLE ERI SILK	0.172	6.641	0.0951
	DYED ERI SILK	0.214*		
	CONTROL SAMPLE TUSSAR SILK	0.900	0.016	0.9898
	DYED TUSSAR SILK	0.110		

DURABILITY PARAMETERS

ABRASION RESISTANCE

The mean value of Eri silk and Tussar silk was found to be 19.1060% and 18.66400 respectively. The abrasion resistance of Eri silk was found to be greater than Tussar silk.

BREAKING STRENGTH

(A) BREAKING STRENGTH (WARP)

The mean value of Eri silk and Tussar silk was found to be 17.14 and 17.66 respectively.The breaking strength of Tussar silk was found to be slightly greater than Eri silk along the warp direction.

(B) BREAKING STRENGTH (WEFT)

The mean value of Eri silk and Tussar silk was found to be 65.30and 15.84 respectively.
The breaking strength of Tussar silk was found to be slightly greater than Eri silk along the weft direction.

COMFORT PARAMETERS

ELONGATION AT BREAK

The Elongation at Break of selected fabrics along warp and weft direction is expressed in centimeters. The elongation at break for Eri silk fabric samples were recorded as 5.538 and for Tussar Silk fabric samples it was 4.729 along the warp direction respectively.

The elongation at break for Eri silk fabric samples were recorded as 11.420 and for Tussar Silk fabric samples it was 10.420 along the weft direction respectively.

The elongation at break of the Eri Silk fabric samples was higher than that of Tussar Silk fabric samples in both warp and weft directions respectively.

BREAKING STRENGTH (kilograms)				
DIRECTION	**FABRIC**	**MEAN**	**'T' VALUE**	**' P' VALUE**
WARP	ERI SILK	17.1400	15.011	0.0423
	TUSSAR SILK	17.6600*		
WEFT	ERI SILK	65.3000*	239.634	0.0027
	TUSSAR SILK	15.8400		

CREASE RECOVERY

The crease recovery angle of Eri silk fabric sample was found to be 98.5 and for Tussar silk fabric sample it was found to be 102.16 along the warp direction respectively. The crease recovery angle of Eri silk fabric was found to be 73 and for Tussar silk Fabric it was found to be 98.46 along the weft direction respectively. Hence, Eri silk fabric showed higher resistance to crease recovery angle than that of Tussar silk fabric respectively.

ELONGATION AT BREAK				
DIRECTION	**FABRIC**	**MEAN**	**'T' VALUE**	**' P' VALUE**
WARP	ERI SILK	5.538	1808.9790	<0.0001**
	TUSSAR SILK	4.729		
WEFT	ERI SILK	11.420	79.3443	<0.0001**
	TUSSAR SILK	10.420		

CREASE RECOVERY ANGLE (DEGREES)				
DIRECTION	**FABRIC**	**MEAN**	**'T' VALUE**	**' P' VALUE**
WARP	ERI SILK	98.5	27.5320	0.001**
	TUSSAR SILK	102.16		
WEFT	ERI SILK	73	437.0856	0.001**
	TUSSAR SILK	98.46		

DRAPABILITY			
FABRIC	DRAPE CO-EFFICIENT %	'T' VALUE	' P' VALUE
ERI SILK	60.46	104.3498	<0.0001**
TUSSAR SILK	57.52		

DRAPABILITY

Fabric drape is often determined by handling them and verifying them how readily they fall into folds. The percentage drape co-efficient was calculated for Eri silk fabric and Tussar silk fabric and was recorded. The drape co-efficient percentage of Eri silk fabric was found to be 60.46 and for Tussar silk fabric it was found to be 57.52. Hence, the result indicates that Eri silk fabric had good drapability in comparison with Tussar silk fabric respectively.

BENDING LENGTH				
DIRECTION	FABRIC	MEAN	'T' VALUE	' P' VALUE
WARP	ERI SILK	1.1600	3.375	0.1834
	TUSSAR SILK	1.3800*		
WEFT	ERI SILK	2.0600*	13.627	0.0466
	TUSSAR SILK	1.6400		

BENDING LENGTH

BENDING LENGTH (Warp & Weft)

The mean value of Eri silk and Tussar silk along the warp direction was found to be 1.1600cm and 1.3800 cm respectively The bending length of Tussar silk was found to be greater than Eri silk along the warp direction. The mean value of Eri silk and Tussar silk along the weft direction was found to be 2.0600cm and 1.6400 cm respectively. The bending length of Eri silk was found to be greater than Tussar silk along the weft direction.

FLEXURAL RIGIDITY (mg.cm)				
DIRECTION	FABRIC	MEAN	'T' VALUE	' P' VALUE
WARP	ERI SILK	138089.6	0.631	0.5456
	TUSSAR SILK	232419.9*		
WEFT	ERI SILK	721543.8*	29.3852	<0.0001**
	TUSSAR SILK	148439.8		

FLEXURAL RIGIDITY
FLEXURAL RIGIDITY (Warp & Weft)

The mean value of Eri silk and Tussar silk along the warp direction was found to be 138089.6mg.cm and 232419.9mg.cm respectively. The flexural Rigidity of Eri silk fabric was found to be greater than that of Tussar silk fabric along the warp direction respectively. The mean value of Eri silk and Tussar silk along the weft direction was found to be 72153.8 and 148439.8 respectively. The flexural Rigidity of Eri silk fabric was found to be greater than that of Tussar silk fabric along the weft direction respectively.

WICKING (cm)				
DIRECTION	**FABRIC**	**MEAN**	**'T' VALUE**	**' P' VALUE**
WARP	ERI SILK	2.97	1113.56	<0.0001**
	TUSSAR SILK	2.48		
WEFT	ERI SILK	4.46	18.0328	<0.0001**
	TUSSAR SILK	4.21		

WICKING

Wicking of Eri silk fabric was recorded as 2.98 and for Tussar silk fabric it was recorded as 2.54 along the warp direction respectively. Wicking of Eri silk fabric was recorded as 4.48and for Tussar silk fabric it was recorded as 4.22 along the warp direction respectively. Wicking of Eri silk fabric was higher when compared to that of Tussar silk fabric along both the warp and weft direction respectively.

SUMMARY

The main objectives of the research were to study the geometric, durability and comfort properties of Eri silk and Tussar silk after dyeing. The laboratory tests were carried out on the two selected samples and the results are summarized.

1.The control sample of the Eri silk had lesser ends per cm and picks per cm when compared to that of the dyed Eri silk fabrics. The same was in the case of the Tussar silk.
2.The fabric weight of Eri silk control samples was found to be of lesser than the Eri silk dyed samples and the fabric weight of Tussar silk control samples was found to be considerably lesser than the Tussar silk dyed samples.
3.The Eri silk control sample had lesser thickness than that of the dyed Eri silk sample. In case of tussar silk fabrics also the thickness was found to be slightly more in the dyed sample than the control sample.
4.The Breaking strength, tussar silk was found to be considerably stronger than eri silk in warp direction. But in the weft direction, eri silk was found to be stronger than tussar silk.
5.As for Abrasion resistance, eri silk fabric showed a higher resistance to abrasion than tussar silk.
6.The elongation at break of the Eri Silk fabric was found to be higher than that of Tussar Silk fabric along both warp and weft directions
7.The wicking property of Eri silk fabric was found to be higher when compared to that of Tussar silk fabric along both the warp and weft direction
8.The Bending length of tussar silk was found to be more than eri silk along the warp direction, and the eri silk was found to be more than tussar silk along the weft direction.
9.The flexural rigidity of tussar silk was found to be more than eri silk along the warp direction and the eri silk was found to be more than tussar silk along the weft direction.
10.The Eri silk fabric showed higher resistance to crease recovery angle than that of Tussar silk fabric.
11.The Eri silk fabric had good drapability in comparison with Tussar silk fabric.

CONCLUSION

Eri silk and Tussar silk are best in their own way attracting people with their aesthetic and appealing appearance. But, when compared, Eri silk overtakes Tussar silk with respect to geometric, durability and comfort properties. It was also found that Eri silk grabbed the top position by showing a remarkable performance on the basis of breaking strength, abrasion resistance, bending length, crease recovery, wicking and drapability thus contributing to better durability and comfort. Hence Eri silk can be recommended for apparel production.

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