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Investigation of the fastness properties and color strength of dry and wet reeled Tasar silk yarns

Rahul Ranjan Ghosh *, Y.C Radhalakshmi, Lakshmikantha N and S. Periyasamy

Central Silk Technological Research Institute, Bengaluru-560068, India.

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Abstract

Tasar silk is extremely sought-after due to its natural beauty, toughness, sustainability, and cultural significance. Despite the historical need for Tasar textiles in their natural hue, weavers have created a limited number of unique designs and variants of Tasar silk. Since the younger generation requires 100% Tasar fabric in a range of items with diverse patterns and color combinations, it has become more vital to dye the Tasar yarn a distinct color. The fastness characteristics and color strength of Acid, Reactive, and Lanaset dye on dry reeled and wet reeled Tasar silk yarns were compared in this paper. In order to assess the yarn samples' color intensity and resistance to rubbing, sweat, washing, and light, they were treated appropriately. The findings of the fastness test showed that, in comparison to other yarns, acid and reactively colored yarns had lower washing and sweat fastness, respectively. Better light fastness was seen in fibers colored with Lanaset. Comparing reactive dyeing to acid and Lanaset dyeing, the former demonstrated a stronger color.

Keywords: Acid Dyeing; Dry Reeled Tasar Silk Yarn; Fastness; Lanaset Dyeing; Reactive Dyeing; Wet Reeled Tasar Silk Yarn

1. Introduction

Copper-colored and gritty in texture, Tasar silk is mostly utilized for interior design and furnishings. The tropical Tasar silk worm, *antherea mylitta*, produces Tasar silk and feeds on Asan and Arjun. A traditional skill practiced by tribal people in Chhattisgarh, Jharkhand, Bihar, Madhya Pradesh, Odisha, Andhra Pradesh, Maharashtra, and West Bengal is cultivating Tasar silk worms for the purpose of producing cocoons [1]. There are two types of reeling methods available for Tasar reeling operations: the wet reeling method and the dry reeling method. The Tasar reeling method is referred to as "dry reeling" if it is performed in the reeling basin without the use of water, and as "wet reeling" if it is performed in the reeling basin with water. The cooking process of both type of yarns are different. Sodium carbonate and sodium bi-carbonate are used for the cooking process of dry reeled yarn but in case of wet reeled yarn hydrogen peroxide, sodium silicate, sodium carbonate are used [2]. It has been observed that in terms of strength, cohesiveness, luster, and other attributes, wet-reeled Tasar silk is superior to dry-reeled Tasar silk [3]. There is a limit to the amount of styles and fabrics that are available, despite the historical need for Tasar textiles in their natural hues. It is now necessary to dye the Tasar silk yarn a distinctive shade since the younger generation demands 100% Tasar cloth in a range of goods with distinctive patterns and color combinations [4]. Tasar silk may be colored with anionic dyes such acids, metal complexes, reactive dyes, and certain direct dyes because of its pH 5.0 isoelectric points and moderately cationic nature [5].

Silk is usually colored with acid and reactive dyes for vivid colors and ease of application because of its protein content [6]. Bright colors, exceptional longevity, and affordability make reactive dyes well-liked. Being able to create covalent bonds with the substrate they are applied to, which gives the dye persistence, sets reactive dyes apart from other types of dyes in textiles. In terms of strength, this covalent link is stronger than van der Waals forces of attraction, ionic bonds,

*Corresponding author: Rahul Ranjan Ghosh; Email: rahulranjanghosh@gmail.com

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and hydrogen bonds [7]. Due to its excellent fastness qualities and ability to generate remarkably brilliant colors, silk is the second most preferred textile fiber to be dyed with acid dyes, behind wool. Acid dyes create neutral solutions and act as strong electrolytes in aqueous solutions because they are strong acid salts that dissolve in water. An ionic connection forms as the primary, but not exclusive, link between the dye and the fiber macromolecule [8]. Reactive dyes and 1:2 metal complex with roughly equivalent dyeing properties and outstanding fastness are included in the Lanaset dye. For every shadow depth, a pH of 5–6 is utilized. The deep rich hues of Lanaset are easily combined, making it a highly useful addition for dyers. They provide excellent wash-fast characteristics on silk. To help create and maintain the dye bath at the desired pH, Lanaset requires the inclusion of auxiliary chemicals [9].

This study assessed the fastness properties of Lanaset, acid, and reactive dyes on dry and wet reeled Tasar silk yarn. Color fastness is the ability of a printed or dyed material to maintain its color under various conditions during production as well as in actual use. Fastnesses to light, rubbing, washing, and perspiration were all examined [10]. However, in light of the current situation, the present study aims to provide dryers in the Tasar region of India with valuable insights on the dyeing behaviors of both wet and dry reeled Tasar silk yarns, with respect to fastness qualities and color strength.

2. Material and Methods

2.1. Materials

One kg of each raw dry reeled and wet reeled Tasar silk yarns have procured from Vanya Silk Reeling Division (VSRD), Central Silk Technological Research Institute (CSTRI), Central Silk Board (CSB). 500 grams of Glauber's salt, 100 grams of Red, Yellow, Blue Acid Dye, Red, Yellow, Blue Reactive Dye, and Red, Yellow, Blue Lanaset Dye, 500 grams of soda ash, 200 grams of sodium acetate, 1000 milliliters of 100% w/v acetic acid, and 50 grams of soap were acquired from the Central Silk Technological Research Institute (CSTRI).

2.2. Working Process Flow

The sequence of operations is shown in the Fig. 1.

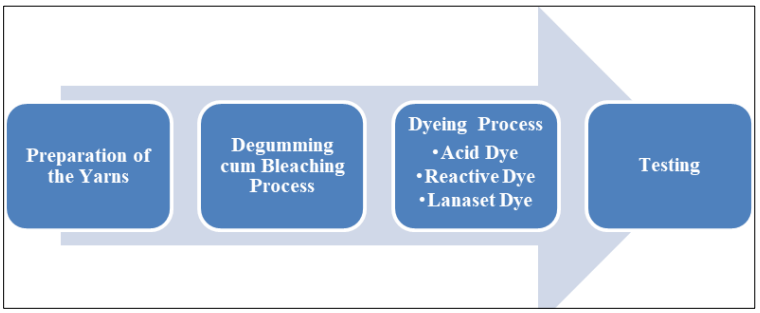

Figure 1 Working process flow

2.3. Yarn Preparation

Two ply twisted raw dry reeled and wet reeled Tasar silk yarns prepared. The details of the yarns are given below Table 1

Table 1 Yarn details of dry reeled and wet reeled

Particulars	Dry Reeled	Wet Reeled
No of Ply	2	
Twist (TPM)	400	
Twist Type	Z	
Avg Denier	150-160	
Tenacity (gm/den)	2.43	2.76
Elongation %	29.39	28.62

2.4. Yarn Degumming cum Bleaching Process

Degumming cum bleaching (D&B) process is applied on both dry reeled and wet reeled Tasar silk yarns as per optimized recipe. Tasar silk yarn is made possible by consistent degumming and bleaching, which is facilitated by employing 18 cc/l of 30% w/v hydrogen peroxide (H_2O_2), 5 g/l sodium silicate (Na_2SiO_3), 1 g/l sodium carbonate (Na_2CO_3), 5 g/l soap, 1 g/l anti- foaming agent and 2 ml/l 100% w/v acetic acid at 90^0C for 30 minutes [11].

2.5. Dyeing Procedures

2.5.1. Acid Dyeing

The recipe of the acid dyeing is shown in the Table 2

Table 2 Acid dyeing recipe

M:L	1:30
Dye	X%on the weight of material
Glauber's Salt	10%on the weight of material
Acetic Acid	4-6%(40% Strength)
Temp and Time	85-90 C for 45 Min
pH	4-6

To produce the dye solution, dissolve the powdered acid dye in boiling water in a separate beaker or pitcher. As per the material to liquor ratio (M: L=1:30), fill the dye bath with the necessary quality of water. Add Glauber's salt and dye solution to the presoaked material, which should be at between 40 and 45°C. Give the content 10 minutes of treatment. After adding acetic acid to the mixture, give the material another10 minutes of treatment. After that, raise the temperature gradually over the next 25 minutes to 85–90 °C. For 45 minutes, treat the material at a high temperature. Next, remove the material and give it a cold wash. Excess water is removed by using hydro extractor. Finally keep the material for drying.

2.5.2. Reactive Dyeing

The recipes of reactive dyeing followed by soaping process are shown in the Table 3 and Table 4 respectively.

Table 3 Reactive dyeing recipe

M:L	1:30
Dye	X%on the weight of material
Glauber's Salt	20%on the weight of material (1st Stage)
Glauber's Salt	20%on the weight of material (2nd Stage)
Soda Ash	5%on the weight of material (1st Stage)
Soda Ash	5% on the weight of material (2nd Stage)
Acetic Acid	4-6%(40% Strength)
Temp (Hot Brand)	70 C
Time	65-75
pH	8-10

Table 4 Recipe of soaping process

M:L	1:30
Soap	1 gpl
Soda Ash	1 gpl
Temp	85 C
Time	15 min

Fill a different beaker or pitcher with hot water and dissolve the necessary dye powder. Fill the dye bath to the necessary level with water as per the material to liquor ratio (M: L = 1:30). At the first stage, add the dye solution along with 20% Glauber's Salt and 5% Soda Ash. Work on the material for 10 minutes. At the second stage, add 20% Glauber's Salt and 5% Soda Ash, and work for 20 minutes. For 45 minutes at 60-70 °C, dyeing the material. Remove the material, then give it a cold wash, proceeded to the Soaping process. Assemble the necessary water, soap, and soda in the soaping bath. After entering the dyed material, gradually raise the temperature to 85 °C. Work for 15 minutes at this temperature. Next, remove the material and give it a cold wash. Excess water is removed by using hydro extractor. Finally keep the material for drying.

2.5.3. Lanaset Dyeing

The recipe of the lanaset dyeing is shown in the Table 5

Table 5 Lanaset dyeing recipe

M:L	1:30
Dye	X%on the weight of material
Glauber's Salt	30 gpl
Sodium Acetate	1 gpl
Acetic Acid	5%on the weight of material(80% Strength)
Temp and Time	75 C for 15 mins
Temp and Time	90 C for 15 mins
pH	5-6

Fill a different beaker or pitcher with hot water and dissolve the necessary dye powder. Fill the dye bath to the necessary level with water as per the material to liquor ratio (M: L = 1:30). Add Glauber's salt, Sodium acetate and acetic acid to the presoaked material, which should be at 40 °C and work for 10 minutes. At the second stage add the dye solution as per the shade requirement and treat for another 10 minutes. After that, raise the temperature gradually to 75 °C and work for 15 minutes. Next, again gradually raise the temperature to 90 °C. For 50 minutes dyeing the material. Next, remove the material and give it a cold wash. Excess water is removed by using hydro extractor. Finally keep the material for drying.

2.6. Yarn Samples Preparation

Acid, Reactive, and Lanaset dyes in 2% dye shades are used to color dry and wet reeled Tasar silk yarns in two different methods. In one, the dyeing is done without the degumming and bleaching step, whereas in the other, the dying is done after. To facilitate testing, the yarn samples are prepared in accordance with the Table 6 below.

Table 6 Yarn Sample details along with Sample Code

Sample Code	Yarn Details	D &B Process	Dyeing Process
D	Dry	No	No
W	Wet	No	No
D- B	Dry	Yes	No
W- B	Wet	Yes	No
D- B- A- R	Dry	Yes	Red- Acid
D- B- A- B	Dry	Yes	Blue- Acid
D- B- A- Y	Dry	Yes	Yellow- Acid
D- UB- A- R	Dry	No	Red- Acid
D- UB- A- B	Dry	No	Blue- Acid
D- UB- A- Y	Dry	No	Yellow- Acid
W- B- A- R	Wet	Yes	Red- Acid
W- B- A- B	Wet	Yes	Blue- Acid
W- B- A- Y	Wet	Yes	Yellow- Acid
W- UB- A- R	Wet	No	Red- Acid
W- UB- A- B	Wet	No	Blue- Acid
W- UB- A- Y	Wet	No	Yellow- Acid
D- B- R- R	Dry	Yes	Red- Reactive
D- B- R- B	Dry	Yes	Blue- Reactive
D- B- R- Y	Dry	Yes	Yellow- Reactive
D- UB- R- R	Dry	No	Red- Reactive
D- UB- R- B	Dry	No	Blue- Reactive
D- UB- R- Y	Dry	No	Yellow- Reactive
W- B- R- R	Wet	Yes	Red- Reactive
W- B- R- B	Wet	Yes	Blue- Reactive
W- B- R- Y	Wet	Yes	Yellow- Reactive
W- UB- R- R	Wet	No	Red- Reactive
W- UB- R- B	Wet	No	Blue- Reactive
W- UB- R- Y	Wet	No	Yellow- Reactive
D- B- L- R	Dry	Yes	Red- Lanaset
D- B- L- B	Dry	Yes	Blue- Lanaset
D- B- L- Y	Dry	Yes	Yellow- Lanaset
D- UB- L- R	Dry	No	Red- Lanaset
D- UB- L- B	Dry	No	Blue- Lanaset
D- UB- L- Y	Dry	No	Yellow- Lanaset
W- B- L- R	Wet	Yes	Red- Lanaset

W- B- L- B	Wet	Yes	Blue- Lanaset
W- B- L- Y	Wet	Yes	Yellow- Lanaset
W- UB- L- R	Wet	No	Red- Lanaset
W- UB- L- B	Wet	No	Blue- Lanaset
W- UB- L- Y	Wet	No	Yellow- Lanaset

2.7. Testing Methods

2.7.1. Fastness Testing

Using ASTM-recommended procedures, the dyed samples were examined for a number of fastness characteristics. Color fastness to washing (AATCC 61), color fastness to rubbing (AATCC 8-1995), color fastness to perspiration (AATCC TM 15-2002), and color fastness to light (AATCC 16-1987) are the particular test methods and standards. Gray scale was also used to assess each sample's color fastness to washing, rubbing, and perspiration. It has nine possible values, which are, in that sequence, 5, 4-5, 4, 3-4, 3, 2-3, 2, 1-2, and 1. 5 denote the “Excellent” and 1 denotes the “Very Poor” fastness properties. Blue scale was used to assess the light fastness of each sample where the 8 signifies “Outstanding” and 1 signifies “Very Poor” light fastness properties [12].

2.7.2. Assessing the Color Strength of Dyed yarns

Color strength refers to how much color a dye can impart to a product. Color intensity is determined by measuring the amount of light absorbed in the visible spectrum. Relative color strength is the percentage representation of the ratio of K/S values for samples in comparison to a standard at the same wavelength. The colored sample's "K" and "S" denote its absorption and scattering coefficients. Using the Kubelka- Munk equation, relative color strength (%) is determined from reflectance, R as follows

$$\frac{K}{S} = \frac{(1-R)^2}{2R}$$

The color measuring spectrophotometer was used to measure the color intensity (K/S value) of the samples at 100 observers using the illuminant D-65 [13].

3. Results and Discussion

3.1. Color Fastness to Light

Table 7 Assessment of Light Fastness of dry reeled and wet reeled Tasar silk yarns

Sample Code	COLOR CHANGE (1-8)	Sample Code	COLOR CHANGE (1-8)
D- B- A- R	5	W- B- A- R	3
D- B- A- B	4	W- B- A- B	4
D- B- A- Y	4	W- B- A- Y	3
D- UB- A- R	5	W- UB- A- R	4
D- UB- A- B	4	W- UB- A- B	5
D- UB- A- Y	4	W- UB- A- Y	3
D- B- R- R	5	W- B- R- R	4
D- B- R- B	4	W- B- R- B	5
D- B- R- Y	5	W- B- R- Y	3
D- UB- R- R	4	W- UB- R- R	4
D- UB- R- B	5	W- UB- R- B	3

D- UB- R- Y	4	W- UB- R- Y	5
D- B- L- R	6	W- B- L- R	5
D- B- L- B	7	W- B- L- B	6
D- B- L- Y	5	W- B- L- Y	5
D- UB- L- R	6	W- UB- L- R	5
D- UB- L- B	7	W- UB- L- B	5
D- UB- L- Y	6	W- UB- L- Y	6

Table 7 showed the results of light fastness of dyed dry reeled and wet reeled Tasar silk yarns. Silk showed little resistance to UV light passing through the fiber and causing photo-degradation processes such photo-oxidation and photo-tendering. It was found that yarns colored with lanaset dye had a better fastness to light than yarns dyed with acid or reactive dyes. The lanaset dye is a mixture of metal complexes and reactive dyes in which the presence of metal ions is crucial. It had increased light-fading resistance because it could absorb UV radiation and transform it into thermal energy. The light fastness properties of dry reeled Tasar silk yarns were comparative higher than wet reeled Tasar silk yarns. It was reflected from the results that there were no significant impact of degumming cum bleaching process before dyeing on light fastness of both dry reeled and wet reeled Tasar silk yarns.

3.2. Color Fastness to Washing

Table 8 Assessment of Washing Fastness of dry reeled and wet reeled Tasar silk yarns

Sample Code	STAIN (1-5)		COLOR CHANGE (1-5)	Sample Code	STAIN (1-5)		COLOR CHANGE (1-5)
	COTTON	SILK			COTTON	SILK	
D- B- A- R	4-5	4	3	W- B- A- R	4-5	4	2-3
D- B- A- B	4-5	4	3-4	W- B- A- B	5	4	2
D- B- A- Y	4	4	3	W- B- A- Y	5	4	3
D- UB- A- R	4-5	4	3	W- UB- A- R	4-5	4	3
D- UB- A- B	4-5	4	4	W- UB- A- B	5	4	2-3
D- UB- A- Y	4	4	3-4	W- UB- A- Y	5	4	2-3
D- B- R- R	4-5	4	4	W- B- R- R	4-5	4	4
D- B- R- B	5	5	4-5	W- B- R- B	5	4	4
D- B- R- Y	5	4	4-5	W- B- R- Y	5	4	3-4
D- UB- R- R	5	4-5	4-5	W- UB- R- R	4-5	4	3-4
D- UB- R- B	5	4-5	4	W- UB- R- B	5	4	4
D- UB- R- Y	5	4-5	4-5	W- UB- R- Y	5	4	4
D- B- L- R	5	4	3-4	W- B- L- R	4-5	4	3
D- B- L- B	4-5	4	4	W- B- L- B	5	4	3-4
D- B- L- Y	5	4-5	3-4	W- B- L- Y	4	4	3
D- UB- L- R	5	4	3-4	W- UB- L- R	5	4	3-4
D- UB- L- B	5	4	3-4	W- UB- L- B	5	4	3-4
D- UB- L- Y	5	4-5	4	W- UB- L- Y	5	4	3

Table 8 showed the results of wash fastness of dyed dry reeled and wet reeled Tasar silk yarns. It was found that reactive colored yarns had better washing fastness than acid dyed yarns. Equalizing acid dyes have low fastness to washing due

to the ease with which dye molecules migrated into and out of the fabric. Conversely, reactive dyed yarns' exceptional washing fastness was facilitated by the covalent link that developed between the dye and the fiber. Moreover, it was observed that Lanaset dyed yarns had a slightly higher washing fastness than Acid dyed yarns, but a lower washing fastness than Reactive colored yarns. What makes Lanaset dyes unique is their capacity to combine with metal ions to create complexes that increase their affinity for fibers. It was also observed from the results that Dry reeled Tasar silk yarns showed better washing fastness than wet reeled Tasar silk yarns. The color fastness to washing value showed poor to fair for Acid dyed yarns whereas reactive dyed yarns showed good to excellent.

3.3. Color Fastness to Rubbing

Table 9 showed the results of wash fastness of dyed dry reeled and wet reeled Tasar silk yarns. Except for acid-dyed wet reeled yarns in a wet condition, it was noticed that there were no appreciable differences in rubbing fastness between dry and wet states of both dry and wet reeled yarns. When the acid-dyed wet reeled yarns were wet, their rubbing fastness value ranged from fair to good; however the other yarns, the values were between good and excellent.

Table 9 Assessment of Rubbing Fastness of dry reeled and wet reeled Tasar silk yarns

Sample Code	GRADE (1-5)		Sample Code	GRADE (1-5)	
	DRY	WET		DRY	WET
D- B- A- R	4-5	4-5	W- B- A- R	4-5	3-4
D- B- A- B	4-5	4	W- B- A- B	4-5	3-4
D- B- A- Y	5	4-5	W- B- A- Y	4-5	3
D- UB- A- R	4	4-5	W- UB- A- R	4	3-4
D- UB- A- B	4-5	4-5	W- UB- A- B	4	3-4
D- UB- A- Y	4-5	4-5	W- UB- A- Y	4-5	3
D- B- R- R	4-5	4	W- B- R- R	5	4-5
D- B- R- B	4-5	4-5	W- B- R- B	5	4-5
D- B- R- Y	4-5	4-5	W- B- R- Y	4-5	4-5
D- UB- R- R	4-5	4-5	W- UB- R- R	4	4
D- UB- R- B	4-5	4-5	W- UB- R- B	4-5	4-5
D- UB- R- Y	4-5	4	W- UB- R- Y	4-5	4
D- B- L- R	4-5	4	W- B- L- R	4	4-5
D- B- L- B	4-5	4-5	W- B- L- B	4-5	4
D- B- L- Y	4-5	4	W- B- L- Y	4	4-5
D- UB- L- R	4-5	4	W- UB- L- R	4-5	4
D- UB- L- B	4-5	4	W- UB- L- B	4-5	4-5
D- UB- L- Y	4-5	4	W- UB- L- Y	5	4-5

3.4. Color Fastness to Perspiration

The results after the assessment of perspiration fastness of dyed dry reeled and wet reeled Tasar silk yarns were tabulated in the Table 10.

Table 10 Assessment of Perspiration Fastness of dry reeled Tasar silk yarns

Sample Code	COLOR CHANGE (1-5)		Sample Code	COLOR CHANGE (1-5)	
	ACID MEDIA	ALKALI MEDIA		ACID MEDIA	ALKALI MEDIA
D- B- A- R	4-5	3-4	W- B- A- R	3-4	3
D- B- A- B	4	4-5	W- B- A- B	3	3-4
D- B- A- Y	4	3-4	W- B- A- Y	4	3-4
D- UB- A- R	4-5	3-4	W- UB- A- R	4	3
D- UB- A- B	4-5	3	W- UB- A- B	4	3
D- UB- A- Y	4-5	4-5	W- UB- A- Y	3-4	3-4
D- B- R- R	3	3	W- B- R- R	2-3	2
D- B- R- B	3	3	W- B- R- B	3	2-3
D- B- R- Y	3-4	3	W- B- R- Y	3	2-3
D- UB- R- R	3	3	W- UB- R- R	2-3	1-2
D- UB- R- B	3	2-3	W- UB- R- B	2-3	1-2
D- UB- R- Y	3-4	3	W- UB- R- Y	3	1-2
D- B- L- R	3-4	3-4	W- B- L- R	3-4	3
D- B- L- B	3-4	4	W- B- L- B	3	3
D- B- L- Y	4	3-4	W- B- L- Y	3-4	3-4
D- UB- L- R	3	3-4	W- UB- L- R	3	3
D- UB- L- B	3	4	W- UB- L- B	3-4	3
D- UB- L- Y	3-4	3-4	W- UB- L- Y	3	3

Compared to acidic media, alkaline media's perspiration fastness had a bigger effect on silk materials that had been dyed. Alkaline solutions caused the silk strand to swell. This was because the silk polymers had been partly split by the alkali molecules. Van der Waal's forces, hydrogen bonds, and salt connections held the silk polymer system together. All of these inter-polymer forces of attraction were hydrolyzed by the alkali, which made the alkaline solution dissolve the silk with ease. The findings showed that when samples were colored with reactive dye, the perspiration fastness of dry reeled and wet reeled Tasar silk yarns was found to be reduced in both acidic and alkaline environments, with values ranging from extremely poor to fair. Regarding the perspiration fastness of fibers colored with Lanaset and Acid, no notable alterations were noted. When it came to yarns colored with acid and lanset, the perspiration fastness shown a decent to exceptional result. Overall, it was found that the qualities of the dry reeled Tasar silk yarns were superior to those of the wet reeled yarns in terms of perspiration fastness.

3.5. Color Strength

The K/S value of dyed dry reeled and wet reeled Tasar silk yarns were calculated and reported in the Table 11. The effect of color strength of primary colors dye i.e. Red, Blue, Yellow on dry reeled and wet reeled Tasar silk yarns were shown in the Fig 2, Fig 3 and Fig 4 respectively. It was reflected from the results that the overall color strength of wet reeled Tasar silk yarns were higher than dry reeled Tasar silk yarns which suggested that the more numbers of dye molecules were absorbed by the wet reeled yarns. The elimination of natural coloring materials, wax, gum, and other materials during the degumming and bleaching process increased the absorbency, resulting in stronger color strength for bleached dyed yarns than for unbleached dyed yarns. It was also noticed from the results that the color strength of reactive dyed yarns were higher followed by acid and lanaset dyed yarns which was observed in both dry reeled and wet reeled Tasar silk yarns. The covalent linkages played a significant role to provide higher color strength. In all dye

classes—acid, reactive, and lanaset—it was observed that blue color dye had lower color strength than red and yellow color dye.

Table 11 Assessment of Color Strength of dry reeled and wet reeled Tasar silk yarns

Sample Code	%R	K/S	Sample Code	%R	K/S
D- B- A- R	71.51	34.76	W- B- A- R	70.84	34.43
D- B- A- B	45.56	21.79	W- B- A- B	54.59	26.30
D- B- A- Y	65.63	31.82	W- B- A- Y	72.78	35.40
D- UB- A- R	48.76	23.39	W- UB- A- R	63.63	30.82
D- UB- A- B	35.7	16.86	W- UB- A- B	43.44	20.73
D- UB- A- Y	48.42	23.22	W- UB- A- Y	66.44	32.23
D- B- R- R	76.88	37.45	W- B- R- R	73.58	35.80
D- B- R- B	55.76	26.89	W- B- R- B	73.96	35.99
D- B- R- Y	75.81	36.91	W- B- R- Y	75.93	36.97
D- UB- R- R	59.00	28.51	W- UB- R- R	61.86	29.94
D- UB- R- B	48.34	23.18	W- UB- R- B	44.85	21.44
D- UB- R- Y	54.55	26.28	W- UB- R- Y	71.49	34.75
D- B- L- R	54.57	26.29	W- B- L- R	64.78	31.40
D- B- L- B	41.66	19.84	W- B- L- B	49.87	23.95
D- B- L- Y	70.58	34.30	W- B- L- Y	72.69	35.35
D- UB- L- R	41.89	19.96	W- UB- L- R	53.08	25.55
D- UB- L- B	36.61	17.32	W- UB- L- B	41.76	19.89
D- UB- L- Y	54.74	26.38	W- UB- L- Y	58.85	28.43

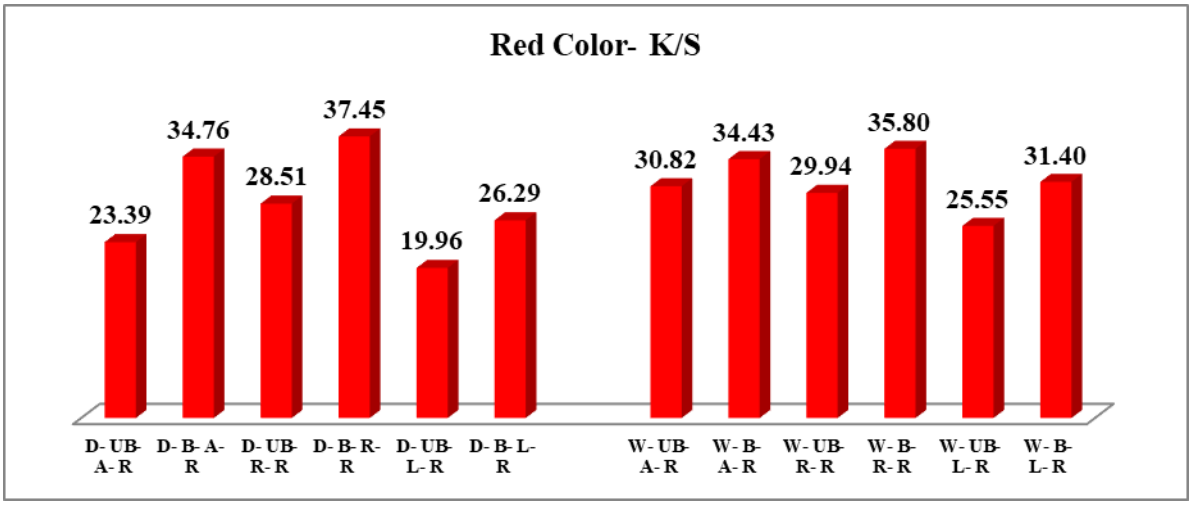

Figure 2 Effect of Color Strength of Red color dye on dry reeled and wet reeled Tasar silk yarns

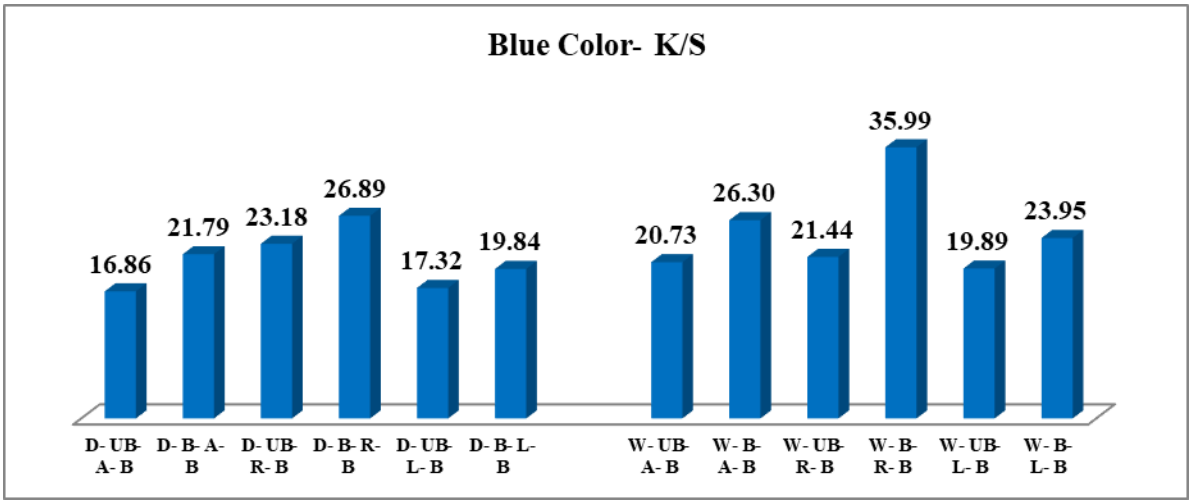

Figure 3 Effect of Color Strength of Blue color dye on dry reeled and wet reeled Tasar silk yarns

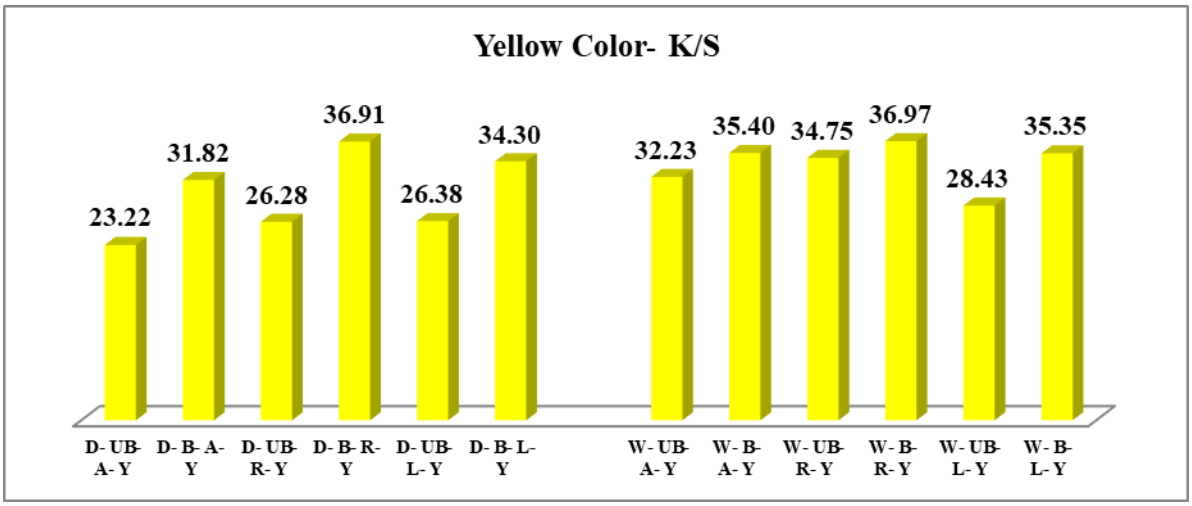

Figure 4 Effect of Color Strength of Yellow color dye on dry reeled and wet reeled Tasar silk yarns

4. Conclusion

In this study, effects of acid, reactive and lanaset dyed dry reeled and wet reeled Tasar silk yarns were investigated by color fastness (washing, Perspiration, light and rubbing) and color strength. It was concluded from the results that the color fastness to perspiration, washing and light were better in dyed dry reeled Tasar silk yarns than dyed wet reeled Tasar silk yarns. The rubbing fastness of acid dyed wet reeled yarns under wet state was showing poor to fair result whereas others were showing good to excellent. Lanaset dyed yarns showed high light fastness properties than acid and reactive dyed yarns but in case of washing fastness, reactive dyed yarns showed the best results. From the results it was noted that the perspiration fastness of reactive dyed yarns showed poor results. The overall color strength of wet reeled Tasar silk yarns were higher than dry reeled Tasar silk yarns. Reactive dye showed the best results in terms of color strength.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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