

Research Article

Application Of Natural Dyes Extracted From Latex Containing Plants On Silk Fabric

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Abstract

Colour is one of the most significant factors in the appeal and marketability of textiles products. Identified medicinal value for many of the natural dyes further enhances its popularity and acceptance. The objectives of this study are to study applications of dyes extracted from latex containing plants on silk fabric. Considering the importance and objectives the experimental procedure was designed. The experimental procedure was divided into three phases likely Phase I – Pilot work of the study, exploration of colors, Phase II – Experiment for dye application to develop a colour palate and Test for assessment of fastness properties and Phase III – Product design and development and its visual assessment for overall impact. From the experiment work and their results we came to the conclusion that the objectives which were framed for the study, get fulfilled satisfactorily.

Key words: Natural dyes, Kalamkari

INTRODUCTION

Nature is full of fascinating colors without which life would have been dull and monotonous. Color is one of the elements of nature that made the human living more aesthetic and fascinating in the world. They are supposed to be associated with emotions, human, qualities, seasons, festivals and passion in our life (V.A. Shenai 1973). Historically, natural dyes were used to color textiles, by the mid-1800's, William Henry Perkin, an English chemist, while attempting to synthesize, accidentally produced and discovered, 'mauve' the first synthetic dye (Padma Vakar 2007). Recently the interest in the use of natural dyes has been growing rapidly due to the result of stringent environmental standards imposed by many countries in response to toxic and allergic reactions associated with synthetic dyes (Anita et al. 2007).

Dyes are broadly classified into two categories natural and synthetic, according to their origin. Natural dyes are further classified into various classes based on their sources, method of applications, structure, color obtained from various dyes (Hess-1974). Historically, plants have been used for the extraction of a majority of natural dyes, various plants parts including roots, leaves, twigs, stems heartwood, bark, wood shaving, flowers, fruits, rinds, hulls, husks, and the like serve as natural dye sources. The existence over 1000 sources of plants based dyes that were used across the world until the early 1900s included in these vast arrays of dyes yielding plants are the following. Heena- from leaves of henna plant Catachu- from resin, fusti- from the wood of the fusti tree, Indigo – from leaves and stems of the indigo plant. Logwood from the core of the logwood tree, turmeric – from the roots of the turmeric plant and saffron from stigmas of the common crows are the common one (Arturo Rajas 2008).

Latex is milky fluid secreted by ducts of lactiferous tissue and mainly flow inside laticifers including roots, stems, leaves and fruits of all flowering plants. It is an emulsion like sticky material the excudes from various plants part after having a small tissue injury. In most plant species latex is squirt out as white glue from bark of plants. It is a complex mixture of protein, alkaloids, starch, sugars, oils, tannins, resins and gums. In most plants,

latex color is normally white, yellow, orange or scarlet but its color changes after an air exposure (Upadhyay R, 2011). The synthetic dyes (azo dyes) are suspected to release harmful chemicals that are allergic, carcinogenic and detrimental to human health and environment. Use of synthetic dyes involves release of enormous amount of hazardous chemicals in the environment during their production of subsequent use (V.H. Kumar 2004).

Nowadays, most of the commercial dyers and textile export and fashion houses have started re-looking to the maximum possibilities of using natural dyes from dyeing and printing of different textiles. Recently interest in the use of natural dyes has been growing rapidly due to the stringent environmental standards imposed by many countries in response to toxic allergic reactions associated with synthetic dye (Kannl et al. 2005). So the Govt. of India has also banned manufacturing, handling and using of some dyes (V.H. Kumar 2004). Recent ban on production and use of unsubstituted benzidine has led all major dye stuff manufacturers to search for benign alternatives. With the world becoming more conscious towards ecology and environment, there is a greater need today to revive the tradition of natural dyes and dyeing techniques as an alternative of synthetic dyes. The safest may be the uses of natural dyes which are not only eco friendly but also prevent environmental pollution. Hence the revival of dyeing with natural/ vegetable dyes has been the need of an hour.

Keeping this in mind, it was considered to be immense importance to explore the natural resources of the region, the survey nearby area was carried out, from the view point of their potential for dye yielding plants was studied, the review of literature helped a lot of choosing the plants for study. While reaching for the dye yielding plants, their morphological features, favorable conditions for propagation have been observed and identified from the viewpoint of cultivation (Deshmukh et al., 2013).

EXPERIMENTAL AND RESULTS

Materials:

Dye Source

Almost any organic material will develop a colour when boiled in a dye bath but only certain plant

will yield a better colour that will act a dye. We had selected five latex containing plants for pilot study, namely *Ficus benghalensis* (family Moraceae), *Achras sapota* (family Sapotaceae), *Artocarpus heterophyllus* (family Moraceae), *Ficus Carica* (family Moraceae), *Fices religiosa* (family Moraceae) and *Carica papaya* (Caricaceae). All the barks were brought from the local supplier and leaves of papaya were collected from vicinity.

Substrate

In today's natural and environmental friendly era, natural, lustrous mulberry silk is the top most natural fabric gaining popularity than other fabrics. Therefore for the present study mulberry silk was selected.

Mordants and chemicals

For pre-treatments of silk samples myrobolan was used. Alum, ferrous sulphate and copper sulphate were three metal mordants and pomegranate rind and babool bark, two vegetable mordants were selected for pilot study. For degumming of silk neutral soap and soda ash were used.

Pilot study

Pilot study was carried out to optimize the dyeing parameters separately for each word / bark extract of latex containing plants which were selected for study on silk fabric.

Preparation of fabric i.e. De-gumming

For pilot study Mulberry silk was chosen as a substrate degumming was done with mild soap and soda ash. For pre-treatment, Myrobolan (Harda) was used. For pre-mordanting, pomegranate rind, babool bark, these two vegetable mordants, and alum, copper sulphate and ferrous sulphate, these three metal mordants were used.

As title suggests six latex containing plants, *Achras sapota*, *Ficus carica*, *Artocarpus heterophyllus*, *Ficus benghalensis*, *Carica papaya*, and *Ficus religiosa* were selected as dye sources. Dyes were extracted by aqueous extraction method; pre-treated, pre-mordanted silk samples were developed with wood extracted dyes. These dyed silk samples were observed carefully, samples coding was done and with the help of color catalogue naming was done to all developed silk samples accordingly.

Visual assessment for colors obtained in pilot study

Coding of color has been done and colors obtained were matched with Asian color palette and naming was done accordingly (color palette). Names given to the silk samples, mordanted and dyed with selected mordants and dyes for pilot study, results are given.

Table 1 reveals color of silk samples when pre-mordanted with myrobolan and mordanted with 20% alum as a single mordant and dyed with *Carica papaya* leaves extract imparted Dijon color (MACP) sample MPRCP obtained Dusty trial color, where as MBBCP exhibited garlic pod color, sample of MFSCP imparted camel, while alum + ferrous sulphate (MAFSCP) with leaf extract obtained dark olive color, linden green gets when mordanted with copper sulphate.

The table 2 shows the results of silk samples when pre-mordanted with myrobolan and mordanted with alum shows Caramel color. The sample MPRFC mordanted with pomegranate rind obtained Balsam brown color while MBBFC imparted latte color when dyed with *Ficus carica*, myrobolan and ferrous sulphated (MFSFC) exhibited antelope color, MCSFC shows medium golden blonde pre-mordanted with copper sulphate and alum, ferrous sulphate mordanted and dyed with *Ficus carica* wood extract exhibited brown bread color.

The table 3 shows the color of myrobolan pre-mordanted and alum dyed with *Ficus religioasa* wood extract exhibited Golden rod color, the sample MPRFR showed Antique gold / blonde color, the sample MBBFR mordanted with babool bark and dyed with same dye imparted. Medium gold shade while + ferrous sulphate mordanted sample (MFSFR) obtained Fawn color, silk mordanted with copper sulphate showed Ochar colour shade with *Ficus religioasa* and alum + ferrous sulphate mordanted reflects Dark Olive shade.

The table 4 shows, the silk sample when pre-treated with myrobolan, mordanted with 20% alum as mordant and dyed with *Achras sapota* wood extract imparted golden rod color, sample MRPAS mordanted with pomegranate rind obtained biscotti color, while sample mordanted with babool bark exhibited Mid cream color, MFSAS ferrous sulphate mordanted imparted flaxen color and copper sulphate mordanted MCSAS reflects deep gold shade, MAFSAS showed Svelte leather color when mordanted with alum and ferrous sulphate combination.

Table 5 shows the result obtained from the mordant + *Ficus benghalensis* combinations. Silk mordant with alum and dyed with *Ficus benghalensis* wood extract exhibits Bronze color, sample MDRFB, MBBFB and MFSFB exhibits. Balsam brown, Peanut butter and Tortilla color respectively while silk mordant with copper sulphate MCSFB imparted Caramel Custard shade and alum + ferrous sulphate showed Branch Brown color shade.

The table 6 shows, silk sample (MAAH) mordanted with alum and dyed with *Artocarpus heterophyllus* showed Bay Brown color, samples MPRAH, MBBAH and MFSAH exhibited brown store, copper coast and copper color respectively. Silk sample mordanted with copper sulphate imparted nut brown color and alum and ferrous sulphate combination mordanted reflects Mexican chocolate color.

The table 7 represented the different pH level obtained by the pH meter for *Carica papaya* is 6.1 ± 0.1 , *Ficus carica* - 5.5 ± 0.1 ; *Ficus religiosa*, *Achras sapota* and *Ficus benghalensis* are 6.1 ± 0.1 , 5.7 ± 0.1 and 5.7 ± 0.1 respectively for *Artocarpus heterophyllus* was observed 6.5 ± 0.1 at room temperature and throughout experimented procedure it was kept original pH (not adjusted).

Table 1: Color catalogue for silk dyed with *Carica papaya* leaf extract with selected mordants

Mordants combinations	Coding	Color obtained
Myrobolan + A	MACP	DIJON
Myrobolan + PR	MPRCP	Dusty trial
Myrobolan + BB	MBBCP	Garlic pod
Myrobolan + FS	MFSCP	Camel
Myrobolan + CS	MAFSCP	Linden green
Myrobolan + AFS	MCSCP	Dark olive

Table 2: Color catalogue for silk dyed with *Ficus carica* wood extract with selected mordants

Mordants combinations	Coding	Color obtained
Myrobolan + A	MAFC	Caramel custard
Myrobolan + PR	MPRFC	Balsam brown
Myrobolan + BB	MBBFC	Latte
Myrobolan + FS	MFSFC	Antelope
Myrobolan + CS	MCSFC	Medium goldon blonde
Myrobolan + AFS	MAFSFC	Brown bread

Table 3: color catalogue for silk dyed with *Ficus religiosa* wood extract with selected mordant

Mordants combinations	Coding	Color obtained
Mordants / combinations	Coding	Color obtained
Myrobolan + A	MAFR	Golden rod
Myrobolan + PR	MPRFR	Antique gold / blonde
Myrobolan + BB	MBBFR	Medium gold
Myrobolan + CS	MCSFR	Ochar
Myrobolan + AFS	MAFSFR	Dark olive

Table-4: Color catalogue for silk dyed with *Achras sapota* wood extract with selected mordant

Mordants combinations	Coding	Color obtained
Myrobolan + A	MAAS	Golden rod
Myrobolan + PR	MPPAS	Biscott
Myrobolan + BB	MBBAS	Mid cream
Myrobolan + FS	MFSAS	Flaxen
Myrobolan + CS	MCSAS	Deep gold
Myrobolan + AFS	MAFSAS	Svelte leather

Table 5: Color catalogue for silk dyed with *Ficus benghalensis* wood extract with selected mordants

Mordants combinations	Coding	Color obtained
Myrobolan + A	MAFB	Bronze
Myrobolan + PR	MPRFB	Balsam brown
Myrobolan + BB	MBBFB	Peanut butter
Myrobolan + FS	MFSFB	Tortilla
Myrobolan + CS	MCSFB	Carmel custard
Myrobolan + AFS	MAFSFB	Branch brown

Table 6: Color catalogue for silk dyed with *Artocarpus heterophyllus* wood extract with selected mordants

Mordants combinations	Coding	Color obtained
Myrobolan + A	MAAH	Bay brown
Myrobolan + PR	MBRAH	Brown stone
Myrobolan + BB	MBBAH	Copper coast
Myrobolan + FS	MFSAH	Copper
Myrobolan + CS	MCSAH	Nut brown
Myrobolan + ACS	MACSAH	Mexican chocolate

Determination of pH of dye extraction from latex containing plants (wood)

In this study for all extract, pH was determined with pH meter at room temperature presented in table 7.

Table 7: pH determination

Sr. No.	Wood Extraction	pH
1.	<i>Carica religiosa</i>	6.1 ± 0.1
2.	<i>Ficus carica</i>	5.5 ± 0.1
3.	<i>Ficus religiosa</i>	6.1 ± 0.1
4.	<i>Achras sapota</i>	5.7 ± 0.1
5.	<i>Ficus benghalensis</i>	5.7 ± 0.1
6.	<i>Artocarpus heterophyllus</i>	6.5 ± 0.1

Results of Visual Assessment

All pre-treated, pre-mordanted, and developed with different dyes, silk samples were subjected to visual evaluation for the color preferences. Samples were evaluated by the panel of judges, and 66 points score card was given to them to put their color preference order i.e. 1 to 6 and asked to rank accordingly. The observations were studied and the results i.e. mean and deviations of the preferences for color were given in table-8.

Table 8 shows that all six dyes are significantly different. Scheffe test helps to show that which dye is different from others. From the above table Sapota and Peepal, Anjeer and Papayaa as well as Banyan and jackfruit are equally effective. But effect of Sapota is differing from Anjeer, Banyan, Jackfruit and Papaya. Effect of Anjeer is different from Banyan, Jackfruit and Peepal. Similarly Effect of Banyan is different from Peepal and Papaya. Effect of Jackfruit is different from Peepal and Papaya, Effect of Peepal is different from Papaya.

From the result, it was observed that color from *Artocarpus heterophyllus* showed best preference with highest score i.e. 5.5, *Ficus benghalensis* scored second with 5.33, *Achras sapota* scored third with score 3.67, *Ficus religiosa* scored 3.5 which is also satisfactory and preferred fourth where as *Ficus*

carica and *Carica papaya* scored 1.67 and 1.33 ranked fifth and sixth respectively.

Laboratory testing for dyed and painted samples

Pre-treated, pre-mordanted samples were dyed with selected dyes extracted from selected plants. After washing, soaping and rinsing all samples were subjected to laboratory testing for their colour fastness properties. All samples were sent for testing and it was done by Regional Laboratory, Textile Committee, (Ministry of Textiles, Govt. of India), Textile testing services, quality cell, Hyderabad.

The washing was performed at 40°C. Alum mordanted and *Ficus benghalensis* dyed sample exhibited fair to good (3-4) in colour change while there is noticeable to slight staining (4-5) observed on the adjacent fabric. White copper sulphate mordanted and *Ficus benghalensis* dyed sample found to be good (4) in colour change and slight to no staining (4-5) observed on the adjacent fabric. Alum mordanted and *Achras sapota* dyed sample showed fair to good (3-4) in colour change and results slight to no staining (4-5) to adjacent fabric, while copper sulphate mordanted and *Achras sapota* dyed shows fair to good (3-4) in color change and results slight to no staining (4-5) on adjacent fabric. Copper sulphate and alum mordanted and

developed with *Artocarpur heterophyllus*, both samples shows fair to good (3-4) in colour change while results slight to no staining (4-5) on adjacent fabric for both the samples.

Alum mordanted and FB dyed sample shows good (4) in colour acidic medium change white excellent (5) in Alkaline medium. There is slight to no staining (4-5) in both the mediums copper sulphate mordanted Fb dyed sample showed good to excellent (4-5) in colour change for both the medium while the dye is good in staining (4), there is slight staining (4) in adjacent silk and cotton fabric in acidic and alkaline mediums. Alum + *Achras sapota* shows good to excellent (4-5) in colour change for both while slight staining shows on adjacent fabric in acidic and alkaline both. Copper sulphate *Achras sapota* shows good to excellent (4-5) in colour change in acidic and alkaline and noticeable to slight staining (3-4) observed in adjacent fabrics. Alum + *Artocarpus heterophyllus* shows good to excellent (4-5) in colour change for both and noticeable to slight staining (4-5) on adjacent fabric (*Artocarpus heterophyllus*). Copper sulphate + Ah shows very poor (1-2) in color change and shows extensive to considerable staining (1-2) on adjacent fabrics in both acidic and alkaline medium.

Alum + *Ficus benghalensis* dyed sample is fair (3) and fair to good (3-4) for weft and warp dry rubbing, while copper sulphate + Fb shows fair (3) to weft and good (4) to warp rubbing. Alum + *Achras sapota* shows good for warp & weft rubbing white copper + *Achras sapota* shows good (4) for both rubbing. Alum + *Artocarpus heterophyllus* shows fair to good (3-4) for both warp and weft rubbing while good (4) for warp / weft rubbing.

Alum + *Ficus benghalensis* and *Achras sapota* both results excellent (5) to light. Alum + *Achras sapota* and copper sulphate + AS also shows excellent (5) to fastness to light while alum + *Artocarpus heterophyllus* shows good to excellent (4-5) & copper sulphate + *Artocarpus heterophyllus* shows good (4) color fastness to light.

Silk samples dyed with *Achras sapota* and mordanted with Alum and Copper sulphate. Silk samples dyed with *Ficus benghalensis* and mordanted with Alum and Copper sulphate. Silk samples dyed with *Artocarpus heterophyllus* and mordanted with Alum and Copper sulphate.

Assessment for Kalamkari samples

Kalamkari painted samples also were sent for properties testing. Alum mordanted and dye from any of the plants sources used Kalamkari painted sample rates good (4) to color change and rates good to excellent (4-5) for staining on adjacent fabric while tested for color fastness to washing. Sample rates good (4) in color change for acidic as well as alkaline medium also rates well to excellent (4-5) for both acidic and alkaline medium for color fastness to perspiration. Sample rates fair (3) for dry rubbing and its fastness to light rating is good to excellent (4-5).

Copper sulphate mordanted and dye from any of the dye from three plants sources used Kalamkari painted samples rates good (4) in color change and rates fair to good (3-4) for staining on adjacent fabric, while tested for color fastness to washing. Sample rates good (4) acidic and alkaline both and also rates fair to good (3-4) for both medium as well for staining on adjacent fabric. Color fastness to rubbing rates fair (3) both warp and weft dry rubbing. Color fastness to light shows good to excellent (4-5) rating to blue wool rating scale. Silk samples Kalamkari painting with *Achras sapota* and mordanted with Alum and Copper sulphate. Silk samples Kalamkari painting with *Ficus benghalensis* and mordanted with Alum and Copper sulphate. Silk samples Kalamkari painting with *Artocarpus heterophyllus* and mordanted with Alum and Copper sulphate.

Assessment of Kalamkari painted crop tops (value addition technique)

In phase III, assessment for designed garments was done. Kalamkari painting was done with selected dyes and mordants. Silk fabrics for all six crop tops were prepared by painting. With the help of patterns were drafted, cut, stitched and finished with proper care as per design.

Results of Assessment of Kalamkari painted crop tops (value addition technique)

The "CROP TOPS" fashion garment were stitched from the different dyed cloth materials and the preference of the different responds towards the choice of the particular dyes are depicted in the table 9. The AH dyed garment were preferred by

young generation followed by FB and then AS dyed.

The above table shows that young generation is not so particular about choosing specifically a traditional design or contemporary design as long as it has a good appeal. They almost preferred both design equally. But preferred contemporary more.

After the preliminary screening only three colour dyes were chosen for the further study, i.e. *Acharas sapota*, *Artocarpus heterophyllus* and *Ficus benghalensis* were taken up. The respondents were asked for their preference among these three colour dyes and the most preferred dye came out to be *Artocarpus heterophyllus* which is 2.8 in colour followed by *Acharas sapota* and although mostly all of them liked the third dye *Ficus benghalensis*, it was the least preferred amongst the three. For a perfect dyeing process, the choice of a proper mordant is an integral part, to go along with our particular dye to ensure a proper and permanent evenly dyed material. So the choice of mordant was also essential for our study. The above table shows the preferences of the respondents among the top three dyes in combination with Alum as a mordant. From above table young generation mostly preferred *Artocarpus heterophyllus* colour with mordant Alum. And the combination of Alum with *Ficus benghalensis* was ranked second and with *Acharas sapota* was ranked third.

The preferences of young generation of the selected dyes in combination with Copper Sulphate as a mordant. It is seen that the most preferred colour mordant combination is *Acharas sapota* with Copper sulphate followed by *Artocarpus heterophyllus* with Copper sulphate and ranked third was the combination of Copper sulphate + *Ficus benghalensis*.

Responses of respondent's about preferences of young generation about Kalamkari Painting (value addition technique)

There is many a styles which are used the increase the appeal of the garments today. Out of the plethora of options we opted to take up the traditional style Kalamkari Painting as the value addition technique, and sought for the respondents' preference or choice as an effective value additive option. Almost 64% respondents thought that Kalamkari Painting is indeed a good option as a value

addition technique. And only about 37% thought that there may be other techniques which would be more effective than Kalamkari Paintings.

Responses of respondent's about preferences of young generation about traditional designs with traditional garments

It was seen that all the respondents showed keen liking towards the tradition designs. But more respondents showed their preference towards these designs clubbed with contemporary or western type of clothing (57%). Although quite a few respondents felt comfortable with these design on traditional garments only (43%).

Responses of respondents about awareness of young generation about eco-friendly / natural colours

While discussing with them the outcome was much to our liking as they are all aware of the eco friendly dyes with 73.33% as and its use in the fashion world for the apparel production. 73% respondents are aware about eco-friendly / natural colours.

Responses of respondents about whether natural, eco-friendly, skin- friendly colours

The study showed that majority of the young generation (63%) preferred these soothing natural, eco-friendly and skin friendly colours over the others and only 36% were apprehensive about their use.

Responses of respondents about overall impact of all aspects i.e.-dyes design and fashion garment

As the study encompasses a wide range of aspects like the impact of dyes, design on the garment as well as the fashion and style, so it was essential to gauge the overall preferences of the respondents especially the young generations. A typical trend was seen which showed that first preference was given to AH plant for all aspects, followed closely by FB and AS at second and third place.

Microbial Assessment of *Acharas sapota*, *Ficus benghalensis* and *Artocarpus heterophyllus* natural dyes

All the three dyes i.e. *Acharas sapota*, *Ficus benghalensis* and *Artocarpus heterophyllus* Natural Dyes showed prominent antimicrobial activity. The two plates showed that all the samples showed a prom-

inent zone of inhibition when compared with the standard-DMSO, as seen in the table11. Thus this shows that all the three dyes have a good anti-

icrobial activity which is also an activity which is shown by all the synthetic dyes available.

Table 8: Mean and SD Sores of preferences

Sr. No.	Plants	Mean preference score	SD of preference score	Ranks
1	Fr	3.5	0.55	IV
2	Fb	5.33	0.82	II
3	Fc	1.67	0.52	V
4	Cp	1.33	0.52	VI
5	As	3.67	0.82	III
6	Ah	5.5	0.55	I

Table 9: Rating given by respondents to the stitched fashion garment (N=30 respondents)

Sr. No.	LC plants	Mean	SD	Rank of Preferences
1	AS	4.17	1.21	III
2	FB	4.60	0.77	II
3	AH	5.4	0.67	I

Table 10: Responses about choice for traditional design or contemporary design

Sr. No.	Responses about preference of	Total	Percentage
1	Traditional	14	46.67
2	Contemporary	16	53.33
3	Total	30	100.00

Table 11. Anti microbial activity shown by the dye samples and standard

Micro-organism Taken	Activity shown			
	Control (DMSO)	<i>Acharas sapota</i>	<i>Ficus benghalensis</i>	<i>Artocarpus heterophyllus</i>
<i>S. aureus</i> (gram+)	+++	+++++	+++++	+++++
<i>E. coli</i> (gram -)	+++	+++++	+++++	+++++

DISCUSSION AND CONCLUSION

From phase – I pilot study: From the result we can conclude that, the color explored from *Achras sapota*, *Ficus benghalensis* and *Artocarpus heterophyllus* obtained best colors out of six obtained selected plants. From golden rod, to Deep gold from *Achras sapota* bronze to Caramel custard from *Ficus benghalensis* and Bay brown to Nut brown and Mexican chocolate from *Artocarpus heterophyllus* were the appealing most and exhibited the best shades.

From Phase – II: The second phase deals with the laboratory testing, as follows. Rating for color fastness to washing. We can conclude that the three

dyes FB, AS and AH exhibited fair to good for color change and showed slight to no staining on adjacent fabric. From the results can be concluded that Alum mordanted and AH, FB and AS dyed samples showed fair to good rating for color change in acidic medium and good to excellent in alkaline medium, while there is slight to no staining observed in both mediums. Copper sulphated mordanted and dyed with FB and AS samples showed fair to good rating for color change except *Artocarpus heterophyllus* in both the mediums. From the results it can be concluded that the alum mordanted and AH, FB & AS dyed silk samples observed fair to good rating for warp and weft rub-

bing while good scored for copper mordanted warp and weft rubbing for all the dyes. From the result we can conclude that the alum mordanted AH, FB and AS dyed samples showed excellent rating for washing and even with copper sulphate and AS, AH and FB dyed samples showed good to excellent for light.

From Phase-III: Rating for stitched fashion garment. On the basis study results it can be concluded that, crop top the ornamented with *Artocarpus heterophyllus*, ranked first followed by *Ficus benghalensis*, second and *Achras sapota* ranked third. Preferences of young generation about Kalamkari painting (value addition technique). From the data it can be concluded that the more percentage 64% of respondents prefer and thought that Kalamkari painting must be a value addition technique. It may be concluded that more percentage of respondents prefers contemporary design. It may conclude that respondents preferred color from *Artocarpus heterophyllus* most and ranked top. It can be concluded that the color obtained from alum with *Artocarpus heterophyllus* preferred most after Alum with *Ficus benghalensis* and *Achras sapota*. Color obtained from copper sulphate with *Achras sapota* preferred most after CS, AH and FB. It can be concluded that the more percentage 64% of respondents prefer and thought that Kalamkari painting must be a value addition technique. We can conclude that the young generation were very well aware about these skin-friendly dyes and exhibited, 73% of respondents are conscious about eco-friendliness. It can be concluded that the very soothing and soft, subtle shades, are liked 63% by the young generation. It can be concluded that for overall impact, the respondents preferred *Artocarpus heterophyllus* dyed and painted crop top most and ranked first, 'dyed and painted with *Ficus benghalensis* crop top ranked second and, the crop top dyed and designed with *Achras sapota* preferred next, ranked third.

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