Effect of Comparative Study on Chiffon and Crinkled Woven Materials using Selected Natural Dyes

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Abstract:

Natural dyes are biodegradable, non-toxic and non-allergenic. They are processed in a way that avoids the use of harmful chemicals during the dyeing and finishing process. They have a much lower environmental impact than synthetic dyes. As of natural origin, natural dyes are not harmful to the environment. This makes it very appealing to the consumers. Natural dyestuffs produce rare colour ideas and are automatically harmonizing. This research was focused on to impart the selected natural dyes to Chiffon and Crinkled cotton woven materials. The shades obtained were effective and had good mechanical and colour fastness. When subjected to antimicrobial tests for antibacterial and antifungal had exhibited excellent zones of inhibition.

Keywords: *antibacterial, antifungal, chiffon, crinkled, natural dyes*

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1. Introduction

In nature, the fruit, flower and leaf of plants show various colour from red to purple and contain various natural dyes which can be extracted by simple procedure. Natural dyes can be barted into three categories: natural dyes obtained from plants, animals and minerals [1]. Natural dyes possess positive attributes such as soft and lustrous colours to the textile dyeing. Many of the plants used for dye extraction are classified as medicinal and some of these have recently beenshown to possess remarkable antimicrobial activity [2]. It is possible to obtain a full range of colours using various mordants. That natural dyes, on the other hand are usually less intense and more prone to bleaching due to mechanical impact, washing or UV irradiation [3]. It is scientifically evaluated for anti-inflammatory, antipyretic, analgesic, larvicidal, insecticidal, antimicrobial, anxiolytic, antidepressant, hepatoprotective, tranquilizing and sedative property. Roots, seeds and leaves of C. ternatea are commonly used in the ayurvedic system of medicine extracts of this plant have been used as an ingredient in the “Ayurvedic Medhya Rasayana” as a rejuvenating recipe used for treatment of neurological disorders and are considered so enhance the intellect [4]. Tecoma Stans is a naturalized in tropical and subtropical areas of Africa, Asia and Oceanica. The entire palm possesses medicinal value and used for the treatment of various ailments. Its fast growth and propagation rates cause it to be regarded as an invasive tree like those in South Africa a Nambia [5]. Tea plant (Camellia sinensis L.) is a source of tea brew which is a very refreshing and popular drink in the world that is defined as the hot aqueous infusion of dried leaves. The flavones present in tea infusions, also called catechins, constitute as much as 20–30% of tea’s dry matter. Terminalia chebula is called the 'King of Medicine' in Tibet and is always listed at the top of the list in Ayur-vedic Materia Medica due to its extraordinary power of healing [6].

It has enjoyed the prime place among medicinal herbs in India ancient times. T. Chebula (fruit) (myrobalan) is one of the most popular Persian herbs used to improve memory function and fruit of T. chebula contains antioxidant ingredients, including ascorbic acid and quercetin, which are effective against oxidative stress-induced neurodegeneration [7]. Antibacterial activity of Terminalia chebula extracts against severe bacterial strain is reported in extracts from different parts of diverse plant species of plants like roots, flower, leaves, seeds etc [8]. Eucalyptus is a fast-growing evergreen tree native to Australia an ingredient in many products, it is used to reduce symptoms of coughs, colds, and congestion. It also features in creams and ointments aimed at relieving muscle and joint pain. Almost every part of this plant has medicinal properties [9].

Cotton fiber is the most important natural fiber used in the textile industry. Cotton known as "The king of Fibres" continues to be the predominant fibre in the Indian textile decent, despite stiff competition from the man-made synthetic fibres [10]. The cotton fiber is made up of countless cellulose molecules. Cotton fibers are natural hollow fibers; they are soft and cool known as breathable and absorbent [11]. Chiffon has a lightweight texture and a semi-mesh weave which is what gives the fabric a chic transparent appearance, as well as making it slightly rough to the touch. Many sheer fabrics are fragile, thin, and delicate; thus, seam slippage is a frequent problem that occurs in the seam line of sewn garments [12]. Crinkle cotton is a soft and stretchy fabric that has been treated to have a lasting textured, wrinkly look. Crinkles in woven fabric as wrinkled from being a part of potential aesthetic interest to the fashion or mass-market garment industry, can be used as a detection and response mechanism in high performance garments [13].

2. Methodology

The methodology of the project comprises the following steps:

2.1 Selection of Fabric

Chiffon fabric (CHº) is sheer, which means that it is light and semi-transparent with a simple weave warp and weft are the two basic components used in weaving to turn thread or yarn into fabric. It is made by passing each filling yarn, over and under each yarn, with each row alternating, producing a high number of intersections. It has the highest number of interlacing as compared with other weaves and therefore it produces the firmest fabrics or some of the most durable fabrics are made in this construction [14]. Crinkled fabric (CRº) is a multi-layer woven fabric consists of at least two layers, which are woven one above the other and stitched together. The investigator selected Chiffon cloth (CHº) and Crinkled cloth (CRº) for the study.

2.2 Selection of Dye and Mordant

Natural dyes and their use in dyeing is probably the most ancient art environmentally friendly substitute for synthetic, non-toxic and an alternative to synthetic dyes that are causing irreversible damage to the planets. A mordant is any substance which can be fixed to fabric and reacts with the dye to produce colours on fabric. So, Natural dye and Natural Mordants was selected for the study.

2.3 Selection of Natural Dyes

Clitoria ternatea L., the blue pea (Plate 1) flower has many functional properties like antidiabetic properties, anti-proliferative properties, antioxidant properties, antimicrobial properties and anticomplusive activity. Tecoma Stans (Plate2) flowers showed anti-diabetic and anti-cancer activity while roots showed antibacterial activity. Camellia Sinensis (Fig.1) is produced by using young tea leaves and sold for consumption without fermentation after withering, steaming or pan firing, drying and grading. In addition, its content minerals and vitamins increase the anti-oxidant potential of this type of tea [15]. Hence Clitoria Ternatea (CT), Tecoma Stans (TS) and Camellia Sinensis (CS) were selected as natural dyes for study.

PLATE 1
CLITORIA TERNATEA

PLATE 2
TECOMA STANS

FIG. 1
CAMELLIA SINENSIS

PLATE 3
MYROBALAN

PLATE 4
EUCALYPTUS BARK

2.4 Selection of Natural Mordants

Myrobalan (M) (Plate 3) has chebulagic acid, tannic acid, corilangin, polyphenolic compounds, triterpenoids, and ascorbate, which found in the dried fruits can be ground into powder and used to produce a buttery yellow dye. Eucalyptus tree barks (Plate 4) fast-growing eucalyptus is one of the major promising cellulose feed stocks for ethanol production in the long term due to its high content of cellulose [16]. Myrobalan was dried in shade and powdered. Eucalyptus bark was taken, broken into pieces, powdered and kept ready for dyeing.

2.5 Selection of Dyeing Medium and Method of Dyeing

Aqueous medium and Fabric dyeing was selected for the study.

2.6 Pilot Study

A Pilot study was conducted for chiffon fabric (CHº) and crinkled cloth (CRº) using three natural dyes Ciltoria Ternatea, Tecoma Stans and Camellia Sinensis with two mordants Myrobalan and Eucalyptus bark.

2.6.1 Process and Dyeing Parameters for Pilot Study

In pilot study, two selected Chiffon cloth (CHº) and Crinkled cloth (CRº) woven fabrics were subjected to three selected Clitoria Ternatea (CT), Tecoma Stans (TS) and Camellia Sinensis (CS) 6% natural dyes with two Myrobalan (M)and Ecualyptus Bark (E) as natural mordants in selected 2%. The selected dyeing parameters for the pilot study of CTM^{CH}, CTM^{CR}, CTE^{CH}, CTE^{CR}, TSM^{CH}, TSM^{CR} , TSE^{CH}, TSE^{CR}, CSM^{CH}, CSM^{CR}, CSE^{CH}, and CSE^{CR} . This was subjected to natural dyeing using three mordanting techniques like pre, simultaneous and post mordanting which gave 18 samples CTM^{CHPR}, CTM^{CHS}, CTM^{CHPO}, CTE^{CHPR}, CTE^{CHS}, CTE^{CHPO}, TSM^{CHPR}, TSM^{CHS}, TSM^{CHPO}, TSE^{CHPR}, TSE^{CHS}, TSE^{CHPO}, CSM^{CHPR}, CSM^{CHS}, CSM^{CHPO}, CSE^{CHPR}, CSE^{CHS} and CSE^{CHPO} in CHº and CTM^{CRPR}, CTM^{CRS}, CTM^{CRPO}, CTE^{CRPR}, CTE^{CRS}, CTE^{CRPO}, TSM^{CRPR}, TSM^{CRS}, TSM^{CRPO}, TSE^{CRPR}, TSE^{CRS}, TSE^{CRPO}, CSM^{CRPR}, CSM^{CRS}, CSM^{CRPO}, CSE^{CRPR}, CSE^{CRS} and CSE^{CRPO} 18 samples in CRº which resulted in thirty six natural dyed samples for pilot study

2.6.2 Selection of Natural Dyed Samples from Pilot Study

From pilot study two samples from natural dyed samples of TSMand two samples from CSE was selected based on the best shades of reproducibility as judged by 500 students from Chikkanna Government Arts College, Tiruppur by showing them the 36 natural dyed samples. The selected natural dyed samples for the study (Fig. 2) was from Post mordanting technique namely TSM^{CHPO}, TSM^{CRPO}, CSE^{CHPO} and CSE^{CRPO} for further study.

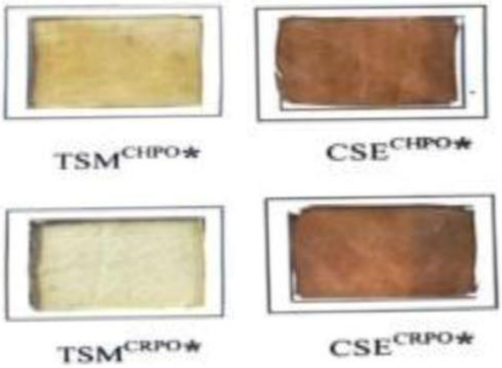


Figure 2: Selected samples for the Study

2.7 Preparation of Natural Dyes and Mordants

To dye CHº, CRº grey fabrics, with the selected post mordanting techniques for further study, desired grams of (6%) Tecoma Stans (TS) dye powder was taken and mixed with M:L ratio of 1:100 ml of water. This mixture was boiled for one and half-an-hour at 50ºC-60ºC temperature for extraction of the natural dye solution. The same process was followed to extract the Camellia Sinensis (CS) dye solution. When two Tecoma Stans and Camellia Sinensis natural dye solutions were ready, they were taken and kept in two separate baths for further process. For mordants preparationdesired grams of Myrobalan (M) and Eucalyptus bark (E) powders of 2% each were taken and mixed in M:L ratio of 1:50 ml of water. This mordant mixture was boiled for half-an-hour at 50ºC-60ºC temperature for the extraction of mordant solution. The mordant solution is kept ready for further dyeing process. Thus, two Natural Dye baths of Tecoma Stans (TS) and Camellia Sinensis (CS) and two mordant baths of Myrobalan (M) and Eucalyptus bark (E) for post mordanting were kept ready for natural dyeing.

2.8 Natural Dyeing of CHº and CRº

The natural dye solutions 6% of Tecoma Stans (TS) and Camellia Sinensis (CS) were taken separately in two baths in M:L ratio of 1:50 for both Chiffon cloth (CHº) and Crinkled cloth (CRº) woven materials. The Chiffon cloth (CHº) and Crinkled cloth (CRº) woven materials which were pre-soaked in water for good absorbency were squeezed out,for excess water and steeped into the respective natural dye baths Tecoma Stans (TS) and Camellia Sinensis (CS), boiled for half-an-hour at 50ºC-60ºC temperature. After the desired time, the natural dyed CHº and CRº with Tecoma Stans (TS) and Camellia Sinensis (CS) were removed and partially dried.

Now, for the mordant baths, for post mordanting, 2% natural mordants Myrobalan (M) and Eucalyptus bark (E) bath solutions which are kept ready, to which each of the natural dyed CHº and CRº fabrics were steeped inside into the respective mordant baths and boiled for 30 minutes at 50ºC-65ºC temperature for natural post mordanting process in two separate dye baths. After the described time of post mordanting the dyed chiffon cloth and crinkled cloth materials were taken, rinsed in cold water and dried in shade. Thus four dyed fabrics TSM^{CHPO}, TSM^{CRPO}, CSE^{CHPO} and CSE^{CRPO} were obtained.

2.9 Evaluation

Evaluation was carried out both subjectively and objectively.

2.10 Fabric Tests

The fabric tests are subjected to the original chiffon cloth (CH^{o}) and Crinkled (CR^{o}) woven fabrics and natural dyed TSM^{CHPO}, TSM^{CRPO}, CSE^{CHPO} and CSE^{CHPO} fabrics for the following Fabric Weight, Fabric Thickness, Tensile Strength and Elongation, Stiffness, Crease recovery, Drape, Abrasion Resistance, Shrinkage, Water Absorbency such asDrop Test, Colour Fastness Tests to Sunlight, Washing, Crocking and Perspiration was done. Anti-Microbial tests suchas Anti-Bacterial test and Anti-Fungal test was also carried out.

2.11 Anti-Microbial Tests

The four natural dyed TSM^{CHPO}, TSM^{CRPO}, CSE^{CHPO} and CSE^{CHPO} fabrics were subjected to Antibacterial and Antifungal Tests. Antimicrobial activity can be defined as a collective term for all active principles (agents) that inhibit the growth of bacteria, fungi prevent the formation of microbial colonies, and may destroy microorganisms [17]. The test plates for antibacterial were examined for the clear zone of inhibition around each control and dyed samples separately for Escherichia coli (Plates 5 - 8) and Staphylococcus aureus (Plates 9 - 12) respectively. The test plates for antifungal were examined for the clear zone of inhibition around each control and dyed samples separately for Candida albicans (Plates 13 - 16) and Candida tropicalis (Plates 17 - 20) respectively.

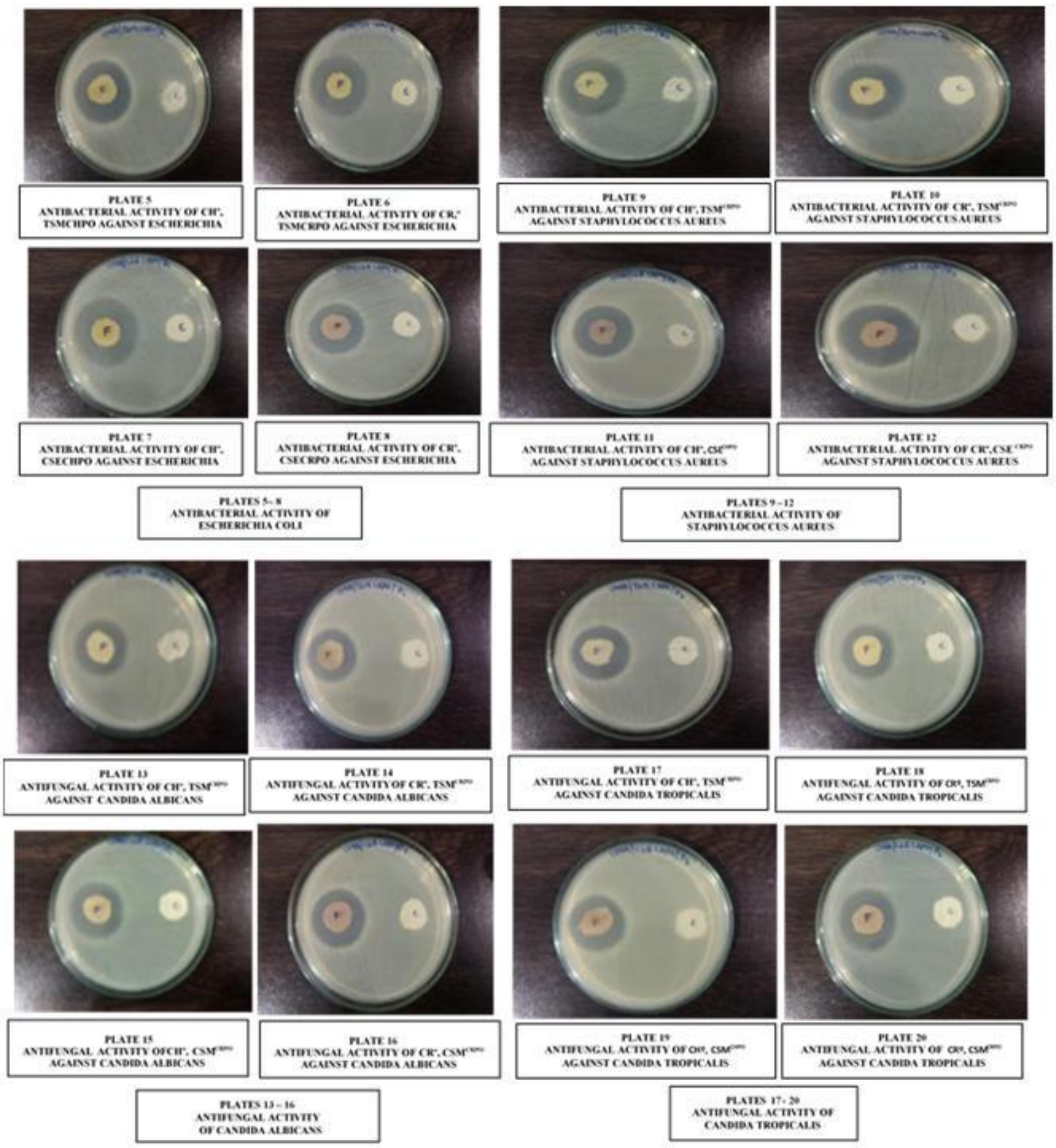


PLATE 5 ANTIBACTERIAL ACTIVITY OF CH°, TSMCHPO AGAINST ESCHERICHIA

PLATE 6 ANTIBACTERIAL ACTIVITY OF CR,° TSMCRPO AGAINST ESCHERICHIA

PLATE 9 ANTIBACTERIAL ACTIVITY OF CH°, TSM AGAINST STAPHYLOCOCCUS AUREUS

PLATE 10 ANTIBACTERIAL ACTIVITY OF CR°, TSM AGAINST STAPHYLOCOCCUS AUREUS

PLATE 7 ANTIBACTERIAL ACTIVITY OF CH°, CSECHPO AGAINST ESCHERICHIA

PLATE 8 ANTIBACTERIAL ACTIVITY OF CR°, CSECRPO AGAINST ESCHERICHIA

PLATE 11 ANTIBACTERIAL ACTIVITY OF CH°, CSE AGAINST STAPHYLOCOCCUS AUREUS

PLATE 12 ANTIBACTERIAL ACTIVITY OF CR°, CSE AGAINST STAPHYLOCOCCUS AUREUS

PLATES 5 - 8 ANTIBACTERIAL ACTIVITY OF ESCHERICHIA COLI

PLATES 9 - 12 ANTIBACTERIAL ACTIVITY OF STAPHYLOCOCCUS AUREUS

PLATE 13 ANTIFUNGAL ACTIVITY OF CH°, TSM AGAINST CANDIDA ALBICANS

PLATE 14 ANTIFUNGAL ACTIVITYOF CR°, TSM AGAINST CANDIDA ALBICANS

PLATE 17 ANTIFUNGAL ACTIVITY OF CH°, TSM AGAINST CANDIDA TROPICALIS

PLATE 18 ANTIFUNGAL ACTIVITY OF CR°, TSM AGAINST CANDIDA TROPICALIS

PLATE 15 ANTIFUNGAL ACTIVITY OFCH°, CSM AGAINST CANDIDA ALBICANS

PLATE 16 ANTIFUNGAL ACTIVITY OF CR°, CSM AGAINST CANDIDA ALBICANS

PLATE 19 ANTIFUNGAL ACTIVITY OF CH°, CSM AGAINST CANDIDA TROPICALIS

PLATE 20 ANTIFUNGAL ACTIVITY OF CR°, CSM AGAINST CANDIDA TROPICALIS

PLATES 13 - 16 ANTIFUNGAL ACTIVITY OF CANDIDA ALBICANS

PLATES 17 - 20 ANTIFUNGAL ACTIVITY OF CANDIDA TROPICALIS

2.12 Construction of Apparel

Four T-shirts were constructed for a seven year girl of 28-size using Tie and dye techniques. The cotton woven dyed Chiffon cloth TSM^{CHPO} and CSE^{CHPO} material were converted to T-shirt using sunburst of marbletie and dye technique (Plates 21, 22). The cotton woven dyed Crinkled cloth TSM^{CRPO} and CSE^{CRPO} material was converted using stripes and circles tie and dye techniques (Plates 23, 24).

PLATE 21 NATURAL DYED TSM^{CHPO}SUNBURSTTIE AND DYE T-SHIRT

PLATE 22 NATURAL DYED TSM^{CRPO} STRIPES TIEAND DYE T-SHIRT

PLATE 23 NATURAL DYED CSE^{CHPO} MARBLE TIEAND DYE T-SHIRT

PLATE 24 NATURAL DYED CSE^{CRPO} CIRCLESTIE AND DYE T-SHIRT

3. Results and Discussion

The results and discussion for the study is given below

3.1 Visual Evaluation of Natural Dyed Samples

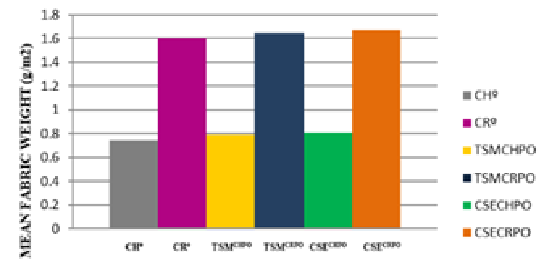
The visual evaluation results show the response percent for all the natural dyed samples. The natural dyed sample CSE^{CRPO} was preferred by 62 % of respondents, TSM^{CRPO} was preferred by 54 % of respondents. CSE^{CHPO} was preferred by 50 % of respondents and TSM^{CHPO} was preferred by 41 % of respondents as received by Chikkanna Government Arts College Tiruppur students. As, these four post mordanting CSE^{CRPO}, TSM^{CRPO}, CSE^{CHPO} and TSM^{CHPO} natural dyed samples exhibited highest rating were selected for the study.

3.2 Analysis of Mechanical Tests

The average Fabric weight, Thickness, Tensile Strength and Elongation, Stiffness, Crease recovery, Drape, Abrasion resistance, Drop Test and Shrinkage. Colour Fastness tests to Sunlight, Washing, Crocking and Perspiration was done. Anti-Microbial Tests such as CSE^{CRPO}, TSM^{CRPO}, CSE^{CHPO} and TSM^{CHPO} Anti-Bacterial Test and Anti-Fungal Test was also carried out. The results for Original and Dyed Chiffon cloth and Crinkled materials is shown in Tables 1,2,3,4,5,6,7,8,9,10 and Figures 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14.

Table 1: Fabric Weight

SAMPLES	MEAN FABRIC WEIGHT (g/m^2)	SD	CV %	% LOSS OR GAIN OVER ORIGINAL
CH°	0.744	0.047	6.31	-
CR°	1.6	0.014	0.87	-
TSMCHPO	0.786	0.028	3.56	5.64
TSMCRPO	1.65	0.021	1.27	3.12
CSECHPO	0.807	0.029	3.59	8.46
CSECRPO	1.676	0.019	1.13	4.75

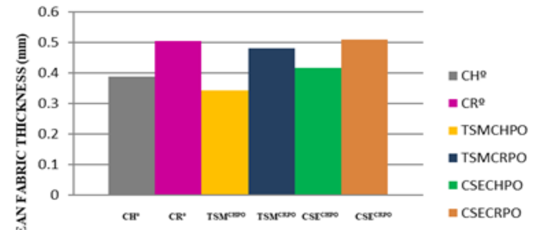


NATURAL DYED SAMPLES OF CHIFFON AND CRINKLED MATERIALS

FIG. 3: FABRIC WEIGHT

Table 2: Thickness

SAMPLES	MEAN FABRIC THICKNESS (mm)	SD	CV %	% LOSS OR GAINOVER ORIGINAL
CH°	0.388	0.106	27.31	-
CR°	0.506	0.880	17.39	-
TSMCHPO	0.343	0.050	686	-11.59
TSMCRPO	0.482	0.055	876.3	-4.74
CSECHPO	0.416	0.030	13.86	7.21
CSECRPO	0.510	0.014	2.74	0.78



NATURAL DYED SAMPLES CHIFFON AND CRINKLED MATERIALS

FIG. 4: FABRIC THICKNESS

Table 3: Tensile Strength

SAMPLES	MEAN TENSILE STRENGTH (Kg/cm^2)		SD		CV %		% LOSS ORGAIN OVER ORIGINAL	
	WARP	WEFT	WARP	WEFT	WARP	WEFT	WARP	WEFT
CHº	82.6	40.36	127.25	4.920	154.05	12.19	-	-
CRº	65.24	18.22	11.147	18.22	17.08	21.99	-	-
TSMCHPO	70.32	32.48	7.097	4.197	10.09	12.92	-14.86	-19.52
TSMCRPO	51.52	21.92	21.660	7.313	42.04	33.36	-21.03	20.30
CSECHPO	38.76	25.34	5.073	6.080	13.08	23.99	-53.07	-37.21
CSECRPO	72.44	20.35	8.986	1.045	12.40	5.13	11.03	11.69

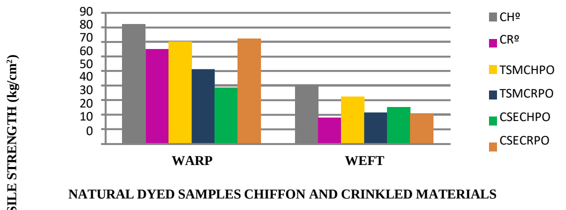


FIG. 5: TENSILE STRENGTH

Table 4: Elongation

SAMPLES	MEAN ELONGATION (cm)		SD		CV %		% LOSS OR GAINOVER ORIGINAL	
	WARP	WEFT	WARP	WEFT	WARP	WEFT	WARP	WEFT
CHº	6.186	3.642	2.628	1.184	42.48	32.50	-	-
CRº	5.226	6.056	1.276	2.501	24.41	41.29	-	-
TSM^{CHPO}	5.933	5.048	1.115	2.223	18.79	44.08	-4.089	39.55
TSM^{CRPO}	5.556	6.334	2.033	2.562	36.59	40.44	6.314	4.59
CSE^{CHPO}	7.282	6.024	2.670	1.966	36.6	32.63	17.71	65.40
CSE^{CRPO}	7.362	10.341	1.488	4.928	20.21	47.65	40.87	70.75

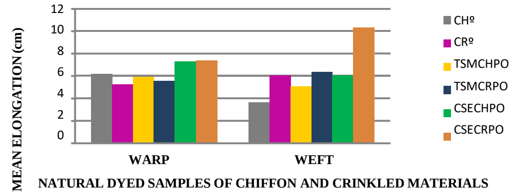


FIG. 6: ELONGATION

Table 5: Stiffness

SAMPLES	MEAN STIFFNESS (cm)		SD		CV %		% LOSS ORGAIN OVER ORIGINAL	
	WARP	WEFT	WARP	WEFT	WARP	WEFT	WARP	WEFT
CHº	1.52	1.47	0.225	0.231	14.80	15.71	-	-
CRº	2.14	2.66	0.107	0.195	5	13.64	-	-
TSM^{CHPO}	1.43	1.38	0.211	0.305	14.75	22.10	-5.92	-6.12
TSM^{CRPO}	2.2	2.7	0.149	0.149	6.77	5.5	2.803	1.503
CSE^{CHPO}	1.68	1.27	0.139	0.194	8.27	15.27	10.52	-13.60
CSE^{CRPO}	2.18	2.7	0.122	0.188	0.55	6.96	1.86	1.503

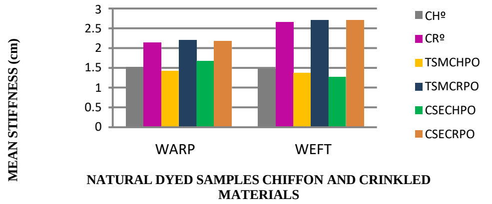


FIG 7: STIFFNESS

Table 6: Crease Recovery

SAMPLES	MEAN CREASE RECOVERY(ANGLE)		SD		CV %		% LOSS ORGAIN OVERORIGINAL	
	WARP	WEFT	WARP	WEFT	WARP	WEFT	WARP	WEFT
CHº	111	122.6	3.829	3.373	3.44	2.75	-	-
CRº	127	70.2	4.422	13.62	3.48	19.40	-	-
TSM^{CHPO}	131.4	85.4	2.458	11.08	1.87	12.98	18.37	-30.34
TSM^{CRPO}	134.5	90	6.883	11.785	5.11	13.09	5.90	28.20
CSE^{CHPO}	131.6	115.2	1.955	19.634	1.48	17.04	18.55	-6.03
CSE^{CRPO}	130.4	96.4	5.440	21.649	4.17	22.44	2.67	37.32

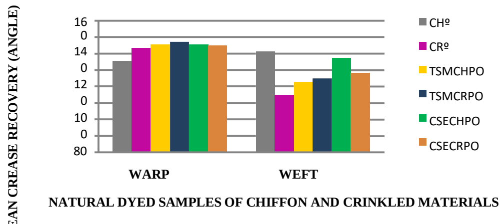


FIG. 8: CREASE RECOVERY

Table 7: Drape Coefficient

SAMPLES	MEAN DRAPE COEFFICIENT(F)	SD	CV %	% LOSS OR GAIN OVER ORIGINAL
CHº	2.375	0.0109	0.46	-
CRº	0.011	0.0415	71.30	-
TSM^{CHPO}	1.376	0.0187	1.38	- 42.06
TSM^{CRPO}	0.010	0.0397	70.89	-9.09
CSE^{CHPO}	0.33	0.0149	4.80	-86.10
CSE^{CRPO}	0.010	0.0388	97	-9.09

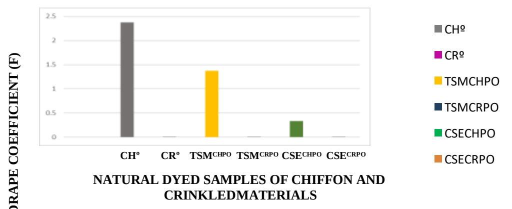


FIG. 9: DRAPE

Table 8: Abrasion resistance						
SAMPLES	**MEAN BEFORE ABRASION (mg)**	**MEAN AFTER ABRASION (mg)**	**WEIGHT LOSS**	**ABRASION VALUE**	**MEAN ABRASION RESISTANCE %**	**% LOSS OR GAIN ORIGINAL**
CH°	13.3	10.31	2.99	0.224	22.5	-
CR°	23.5	20.26	3.24	0.137	13.8	-
TSM^{CHPO}	12.6	11.52	1.08	0.361	36.12	60.53
TSM^{CRPO}	10.63	21.62	2.01	0.620	62.03	349.49
CSE^{CHPO}	20.71	10.94	1.77	0.591	59.2	163.11
CSE^{CRPO}	24.5	21.29	3.21	0.990	99.1	618.11

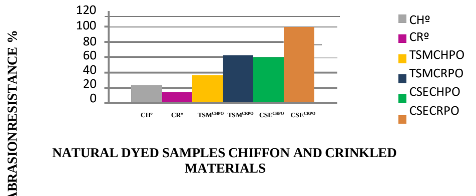


FIG. 10: ABRASION RESISTANCE

Table 9: Drop Test	
SAMPLES	**MEAN DROP TEST (sec)**
CH°	0.46 sec
CR°	0.29 sec
TSM^{CHPO}	19 sec
TSM^{CRPO}	1 min 20 sec
CSE^{CHPO}	19 sec
CSE^{CRPO}	1 min 24 sec

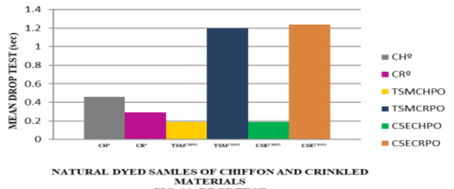


FIG. 11: DROP TEST

Table 10: Shrinkage										
SAMPLES	**MEAN SHIRNKAGETEST (cm)**		**MEAN SHRINKAGE %**		**SD**		**CV %**		**% LOSS OR GAINOVER ORIGINAL**	
	WARP (L=1cm)	**WEFT (L=1cm)**	**WARP**	**WEFT**	**WARP**	**WEFT**	**WARP**	**WEFT**	**WARP**	**WEFT**
CH°	0.78	0.76	22	24	0.078	0.117	10	15.39	-	-
CR°	0.88	0.84	12	16	0.042	0.051	4.77	6.07	-	-
TSM^{CHPO}	0.76	0.80	24	20	0.107	0.066	14.07	8.25	-2.56	-89.47
TSM^{CRPO}	0.79	0.79	21	21	0.110	0.083	13.92	10.50	-10.22	-5.95
CSE^{CHPO}	0.84	0.73	16	27	0.072	0.133	8.57	18.21	7.69	-3.94
CSE^{CRPO}	0.74	0.79	26	21	0.117	0.087	15.81	11.01	-15.90	-5.95

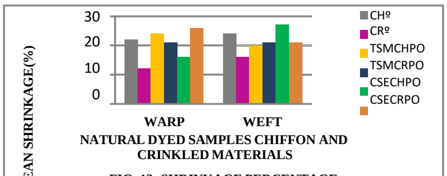


FIG. 12: SHRINKAGE PERCENTAGE

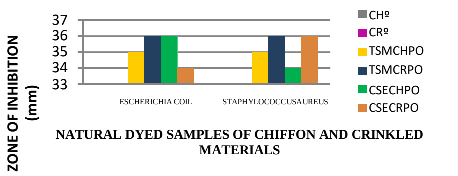


FIG. 13: ANTIBACTERIAL TEST

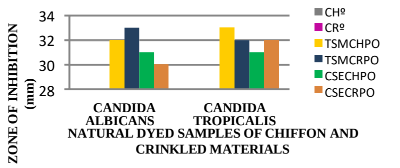


FIG. 14: ANTIFUNGAL TEST

From Table 1 and Fig. 3 it shows that when means were compared between original fabrics, CR° revealed higher fabric weight by 1.6 g/m² whereas CH° had 0.744 g/m². When compared within means of natural dyed four samples CSE^{CRPO} showed highest fabric weight of 1.676 g/m² followed by TSM^{CRPO} 1.65 g/m² and CSE^{CHPO} 0.807 g/m². The least fabric weight was seen in TSM^{CHPO} of 0.786 g/m². When dyed samples were noted for percent loss or gain over original, all four natural dyed samples showed a gain in fabric weight. The highest percent gain was noted in CSE^{CHPO} by 8.46 % and the least percent gain of 3.12% was noted in TSM^{CRPO}.

From Table 2 and Fig. 4 it shows that when means were compared between original fabrics, CR° revealed higher fabric thickness by 0.506 mm whereas CH° had 0.388 mm. When compared within means of natural dyed four samples CSE^{CRPO} showed highest fabric thickness of 0.510 mm. The least fabric thickness was seen in TSM^{CHPO} of 0.343 mm. Whereas TSM^{CRPO} and CSE^{CHPO} had moderate thickness. When dyed samples were noted for percent loss or gain over original, the highest thickness percent gain was noted in CSE^{CHPO} by 7.21 % and the least percent gain of 0.78 % was noted in CSE^{CRPO}.

From Table 3 and Fig. 5 for warp tensile strength when means were compared between original fabrics, CH° had the highest 82.6 kg/cm^2 followed by CR° having 65.24 kg/cm^2 as warp tensile strength. When compared between means of four natural dyed samples, CSE^{CRPO} showed highest warp tensile strength as 72.44 kg/cm^2. The least warp tensile strengthwas seen in CSE^{CHPO} having 38.76 kg/cm². Whereas TSM^{CHPO} and TSM^{CRPO} showed 70.32 kg/cm^2 and 51.52 kg/cm^2 warp tensile strength in fabrics. When dyed samples were noted for warp tensile strength percent loss or gain over original, thewarp tensile strength 11.03 percent gain was noted in CSE^{CRPO}.

From Table 4 and Fig. 6 for warp elongation when means were compared between original fabrics, CR° had the best 5.226 cm warp elongation followed by CH° having 6.186 cm warp elongation. When compared between means of four natural dyed samples, TSM^{CRPO} showed 5.556 cm as best warp elongation among the other three dyed samples. For weft elongation when means were compared between original fabrics, CHº had the best 3.642 cm weft elongation followed by CRº having 6.056 cm weft elongation. When compared between means of four natural dyed samples, TSM^{CHPO} showed 5.048 cm as best weft elongation among the other three dyed samples. When dyed samples were noted for warp elongation percent loss or gain over original, the best warp elongation of 6.314 percent gain was noted in TSM^{CRPO}. When dyed samples were noted for weft elongation percent loss or gain over original, all the four natural dyed samples exhibited a gain in weft elongation. The best weft elongation of 4.59 percent gain was noted in TSM^{CRPO}.

From Table 5 and Fig. 7 for warp stiffness when compared between means of original fabrics, CRº had the highest 2.14 cm warp stiffness followed by CHº having 1.52 cm warp stiffness. When compared between means of four natural dyed samples, CSE^{CRPO} having 2.18 cm as highest warp stiffness and the least warp stiffness of 1.43 cm was seen in TSM^{CHPO}. For weft stiffness when compared between means of original fabrics, CRº had the highest 2.66 cm weft stiffness followed by CH° having 1.47 cm weft stiffness. When compared between means of four natural dyed samples, TSM^{CRPO} and CSE^{CRPO} had shared equally the highest 2.7 cm weft stiffness and the CSE^{CHPO} having 1.27 cm as least weft stiffness. When dyed samples were noted for warp stiffness percent loss or gain over original, the highest percent gain was noted in CSE^{CHPO} which had 10.52 % and the least 1.83 percent gain was noted in CSE^{CRPO}. When dyed sampleswere noted for weft stiffness percent loss or gain over original, percent gain was equally shared between TSM^{CRPO} and CSE^{CRPO}.

From Table 6 and Fig. 8 for warp crease recovery when compared between means of original fabrics, CHº had the fastest crease recovery by 111º followed by CRº having 127º. Amongst the four natural dyed materials best crease recovery was seen in CSE^{CRPO} by 130.4º and followed by TSM^{CHPO} and CSE^{CHPO} having 131.4º, 131.6º crease recovery. For weft crease recovery when compared within original samples. CRº had the fastest recovery by 70.2°. Between four natural dyed materials best crease recovery was noted in TSM^{CHPO} having 85.4º followed by TSM^{CRPO} and CSE^{CRPO} having 90º, 96.4º crease recovery. When compared for percent loss or gain over original for four natural dyed samples, allthe samples exhibited a gain in warp crease recovery. The best warp crease recovery percent was seen in CSE^{CRPO} and TSM^{CRPO} had the best weft percent crease recovery.

From Table 7 and Fig. 9 it shows that when means were compared between original fabrics, the drape was found to be higher in CHº by 2.375 F followed by CRº having 0.011 F. Within four natural dyed samples the drape was higher in TSM^{CHPO} of 1.376 F. The four samples had a loss percent in drape.

From Table 8 and Fig. 10 it shows that when abrasion resistance percent was compared between original fabrics, CR° revealed higher fabric abrasion resistance by 13.8 % whereas CH° had 22.5 %. When compared within abrasion resistance percent of natural dyed four samples TSM^{CHPO} showed highest abrasion resistance of 36.12 %. The least fabric abrasion resistance of 59.2 percent was seen in CSE^{CHPO}. When dyed samples were noted for percent loss or gain over original, all the four natural dyed samples exhibited a gain in abrasion resistance. The highest percent gain was noted as 618.11% by CSE^{CRPO} and the least percent gain of 60.53% was noted in TSM^{CHPO}.

From Table 9 and Fig. 11 it shows that when means were compared between original fabrics, CRº has the highest absorbency nature by 0.29 sec whereas CH° wetted the fabric by 0.46 sec. When compared between means of four naturaldyed samples, TSM^{CHPO} and CSE^{CHPO} both showed good absorbency by 19 sec respectively.

From Table 10 and Fig. 12 for warp shrinkage when compared between means of original fabrics, CHº had less 0.78 cm followed by CRº having 0.88 cm warp shrinkage. When compared between means of four natural dyed samples, CSE^{CRPO} having 0.74 cm as least warp shrinkage and the highest warp shrinkage of 0.79 cm was seen in TSM^{CRPO}. For weft shrinkage when compared between means of original fabrics, CHº had less 0.76 cm followed by CR° having 0.84 cmweft shrinkage. When compared between means of four natural dyed samples, CSM^{CHPO} having 0.73 cm as least weft shrinkage followed by TSM^{CRPO} and CSE^{CRPO} which shared equally of 0.79 cm weft shrinkage and the TSM^{CRPO} having 0.79 cm as highest weft shrinkage. When dyed samples were noted for percent loss or gain over original, the percent loss or gain in warp shrinkage was noted in CSE^{CHPO} which had 7.69 %.

3.3 Analysis of Colour Fastness Tests

The result obtained for colour fastness to sunlight shows that the colour change when analyzed for the four natural dyed TSM^{CHPO}, TSM^{CRPO}, CSE^{CHPO} and CSE^{CRPO} materials, reveal that all the four natural dyed samples had slight change in colour. When checked for colour fastness to washing all the four natural dyed fabrics showed no colour change.With regard to colour staining TSM^{CHPO} had slight colour staining compared to the other three TSM^{CRPO}, CSE^{CHPO} and CSE^{CRPO} natural dyed samples. With regard to Wet crocking, all the four natural dyed samples showed no colour change and slight colour staining was noted in TSM^{CHPO} whereas all the other three had no colour staining. In Dry crocking, all the samples exhibited no colour change and colour staining. For the effect of acid and alkali perspiration, all the four natural dyed TSM^{CHPO}, TSM^{CRPO}, CSE^{CHPO} and CSE^{CRPO} samples exhibited noticeable slight colour change and staining.

3.4 Analysis of Anti-Microbial Tests

Anitimicrobial Tests of Antibacterial and Antifungal Tests were carried out on original and dyed Chiffon and Crinkled fabrics.

From Fig. 13, Original control CH^{o}, CR^{o} fabric samples did not show any inhibitory zones indicating the absence of antibacterial surface finishing. TSM^{CRPO}, CSE^{CHPO} showed 36 mm inhibitory zones each respectively and TSM^{CHPO}, CSE^{CRPO} showed 35 mm and 34 mm inhibitory zones against test bacteria Escherichia coli. Whereas TSM^{CRPO}, CSE^{CRPO} had 36 mm each respectively and TSM^{CHPO} had 35 mm, CSE^{CHPO} had 34 mm inhibition zones were found in Staphylococcus aureus. All the four natural dyed samples had good inhibitory zones against bacteria.

From Fig. 14, original control CH^{o}, CR° fabric samples did not show any inhibitory zones indicating the absence of antifungal surface finishing. TSM^{CRPO}, TSM^{CHPO}, CSE^{CHPO} and CSE^{CRPO} had 33 mm, 32 mm, 31 mm and 30 mm inhibitory zones against test fungi Candida Albicans. Candida Tropicalis showed TSM^{CHPO}, TSM^{CRPO}, CSE^{CRPO}, CSE^{CHPO} had 33 mm, 32 mm, 32 mm and 31 mm inhibitory zones. All the four natural dyed samples had good inhibitory zones against fungi.

4. Summary and Conclusion

Environmentally safe products are gaining popularity in recent years, so it has become extremely important for textile chemists and colourists to find eco-friendly ways of producing colours for textiles [18]. The four natural dyed TSM^{CHPO}, TSM^{CRPO}, CSE^{CHPO} and CSE^{CRPO} samples exhibited good shades. The mechanical tests conducted on these natural dyed fabrics revealed that they had good strength and drape, best abrasion resistance, crease recovery andstiffness. The natural dyed samples showed good water absorbency in drop test and shrinkage test. The natural dyed samples showed best colour fastness to sunlight, washing, wet crocking. dry crocking and perspiration. The antibacterial and antifungal test results of natural dyed fabrics reveal that they had good zones of inhibition.

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