ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(9): 1027-1032
www.allresearchjournal.com
Received: 07-06-2015
Accepted: 09-07-2015

Swati Pradhan
MSc. Student, Textile and Apparel Designing, Ethelind School of Home Sci. Shiats, Allahabad.

Nargis Fatima
Asst. Prof. Textile and Apparel Designing, Ethelind School of Home Sci. Shiats, Allahabad.

Ekta Sharma
Asst. Prof. Textile and Apparel Designing, Ethelind School of Home Sci. Shiats, Allahabad.

Correspondence
Nargis Fatima
Assistant professor, Textile and Apparel Designing, Ethelind School of Home Sci. Shiats, Allahabad.211007
Ph. 9721660787

Printing of cotton fabric with reactive dyes using *Aloe vera* gel as printing thickener

Swati Pradhan, Nargis Fatima, Ekta Sharma

Abstract
The present study was undertaken with the objectives to optimize various concentrations of reactive dye using aloevera gel, to test the physical and color fastness properties of the printed samples and to develop various articles by utilizing prepared optimized recipes and calculate their cost. The reactive dye with different concentrations was optimized and the best result was selected on the basis of physical testing, color fastness testing and visual evaluation. Reactive dye concentration of 3g was selected as best. Vinegar with different concentrationswere also optimized for after treatment of selected reactive dye printed samples and the best results was selected on the basis of physical testing, color fastness testing and visual evaluation. 10% vinegar concentration for 4g reactive dye was selected as best. Selected concentration of vinegar was again treated in different time periods. In case of after treatment reactive dye showed good results with 10% vinegar for 5 minutes treatment. Physical properties, drape, crease recovery, thickness, stiffness of all printed and treated samples showed good results. Color fastness properties were also found to be satisfactory. All the articles printed and treated with optimized recipes were highly appreciated as these were cost effective. The cost of prepared products varying from ₹ 332.12 to ₹ 250.80.

Keywords: Aloevera gel, reactive dye, color fastness properties, thickener, printing.

1. Introduction
Printing, as an art, originated a few thousand years ago and its development continues till date. In this fast changing world, printing is most important of all the processes used at present to decorate textile materials. With the use of synthetic thickener in printing industry many of the harmful effects are produced in the environment and to reduce this effect an environment friendly thickener can be used. Natural thickeners being widely distributed throughout the plant kingdom, they are easily available and present in abundance. As the ingredients of natural thickener are purely natural they are non-allergic and non-toxic to our body and cause no health hazard. Aloevera gel possesses some biological activities such as promotion of wound healing, antifungal activity, hypoglycemic or anti-diabetic effects, as well as anti-inflammatory, anticancer and gastro protective properties. The gel is a viscous, colorless, transparent gel. With all these properties aloevera gel can be used as a printing thickener for cotton fabric which will not produce any harmful effect on human body which synthetic thickener may produce.

Material and Methods
Materials
Cotton fabric was selected for the study. The thickener used in the present study was natural thickener aloevera gel which was obtained from aloevera leaves. Reactive dye was used for the printing of cotton fabric as these dyes are more suitable for cellulosic fabrics. Some chemicals such as
Urea(NH_2CONH_2), Trisodium phosphate (Na_3PO_4), Vinegar, Sodium hydroxide (NaOH), Wetting agent (Soap), Sodium chloride(NaCl), and Acetic acid(CH_3COOH) used in the present study.

Methods
Scouring of cotton
Before printing, the entire length of cotton fabric was soaked overnight in water to remove the natural and added impurities that hinder the subsequent operation of printing. The fabric

was then boiled in a solution containing 2 g soap and 1gNaOH / liter of water for 45 min. It was kneaded, squeezed in the soap solution. After, fabric was partially dried in shade and ironed when half wet.

Extraction of aloevera gel

Wider and thicker aloevera leaves were choosen because it contains more gel. The leaves were laid flat on a cutting board, and was cut off the tip about 1/2 an inch down. The ragged edges that go down the length of the leaves were cut off on both sides. The fillet knife was taken and sliced in half lengthwise from top to bottom. The two leaf was laid half down next to each other with the inside facing up. The spoon was taken and gel was scraped from inside of the leaves. The gel was put into a jar and stored in the refrigerator. The gel was kept in the shade to prevent spoilage. In the refrigerator, the aloevera gel can last for up to 6 months.

Preparation of printing paste

For the preparation of printing paste by using aloevera gel as thickener with reactive dye the following recipe as given byEl-Zairy, (2011) [2] was used.

Reactive dye -1-5%
Thickener -50 g
Urea -7.5g
Tri sodium phosphate -1g

The printing paste was prepared by adding all the ingredients (Tri sodium phosphate, urea and reactive dye) in given amount to the aloevera gel. The paste was mixed well and kept for 2-3 hrs before printing. Then the samples were printed with the prepared paste of aloevera gel and reactive dye.

Optimization of dye concentration

The dye concentration for thickener was optimized. The printing paste were prepared separately by taking 1, 2, 3, 4, 5 g dye concentration keeping the other ingredients same as taken earlier (recipe given byEl-Zairy, 2011) [2]. Samples were printed with these pastes using screen and samples were subjected to physical testing, color fastness testing and visual evaluation, the best dye concentration was optimized for product development.

Visual evaluation of printed samples

All the printed samples were subjected to visual evaluation for the selection of best dye concentration. A panel of 20 judges including staff members and students evaluated the printed samples. The attributes assigned for evaluation were depth of shade, evenness of dye, texture and luster and overall appearance. Five point scales was used for the evaluation. Score one, two, three, four and five were assigned for poor, fair, good, very good and excellent, respectively.

Physical testing and color fastness testing of printed sample

The final printed samples (treated and untreated) were subjected to physical and color fastness testing such as thickness test, fabric stiffness test, crease recovery test, drape, color fastness to washing, color fastness to perspiration and color fastness to crocking.

Product development and cost determination

Apparel articles skirt and kurti were prepared by using optimized printing recipes. The cost of each product was determined on the basis of raw material used, labor charges, finishing cost of the product and 25% profit margin was also included.

Results and Discussion

Visual evaluation of printed samples for selection of dye concentration

It is evident from the table 1 that the maximum average for reactive dye was scored by 3g dye concentration hence it was selected as optimum concentration.

Table 1: Visual evaluation score for selection of dye concentration

Thickener used	Dye used	Dye concentration (g)	Average score
Aloevera gel	Reactive dye	1	3.56
		2	3.58
		3	3.8
		4*	04.38
		5	3.66

Maximum score – 5

Physical properties of printed samples in different dye concentrations

It is evident from the table 2, that the thickness of the printed samples ranges from 0.30 mm to 0.32 mm. Reactive dye drape coefficient value ranges from 0.34 to 0.37 and with the increase in dye concentration the drape coefficient of fabric decreased and the fabric became softer.

Table 2: Drape, thickness, bending length and crease recovery of cotton fabric printed with different dye concentrations

Thickener used	Dye used	Dye concentration(g)	Drape coefficient	Thickness(mm)	Bending length (cm)		Crease recovery	
					warp	weft	warp	weft
Aloeveragel	Reactive dye	1	0.37	0.30	3.6	3.9	104˚	86˚
		2	0.36	0.32	3.9	4.2	102˚	85˚
		3	0.34	0.32	3.9	4.2	102˚	82˚
		4*	0.35	0.32	4.2	4.4	101˚	82˚
		5	0.34	0.32	4.2	4.6	100˚	81˚

* Selected concentration

It is clear from the table 2, that the aloevera gel with reactive dye that bending length showed values ranging from 3.6 cm to 4.2 cm in warp direction and 3.9 cm to 4.6 cm in weft direction. The printed samples in the warp direction showed less bending length as compared to weft direction. Reactive dye printed samples showed 104˚ to 100˚ crease recovery angle in warp direction and 86˚ to 81˚ crease recovery angle in weft direction.

Color fastness of printed samples

All printed samples were subjected to various color fastness testing such as light, washing, perspiration and crocking and the results are reported in table 3.

Table 3: Light, washing, perspiration and crocking fastness of cotton printed with different dye concentrations

Thickener used	Dye used (g)	Dye concentration (g)	Light fastness	Washing fastness		Perspiration fastness				Crocking fastness			
						Acidic		Alkaline		Dry		Wet	
				CC	CS	CC	CS	CC	CS	CC	CS	CC	CS
Aloevera gel	Reactive dye	1	7	3	2	4	4	3	3	4	4	3	2
		2	7	4	2 2	4	3	3	3	4	4	2	2
		3	7	4	2	5	3	3	3	4	4	3	2
		4*	7	3	2	4/5	4	2/3	3	4	4	2	2
		5	7	2	2	4/5	3	3	3	4	3	2	2

CC - Change in color, CS – Color staining, * Selected concentration

According to the table 3, the light fastness of reactive dye printed samples with different dye concentrations showed excellent light fastness (7). The color fastness to washing for reactive dye showed considerable (2) color staining, but change in color was considerable (2) to negligible (4). From the overall reading, when the dye concentration increased the result of color staining became poor. Reactive dye with different dye concentration in perspiration fastness, the color change was found 4 to 5 in acidic perspiration solution and 2/3 to 3 (i.e. considerable to noticeable change) in alkaline perspiration solution but in color staining showed 3 to 4 (i.e. noticeable to slightly stained) for both acid and alkaline perspiration. Color fastness to crocking was rated both in dry and wet condition with respect to change in color and staining on cotton test samples. It was found that the result of dry crocking fastness of reactive dye was much better than the wet crocking fastness. The color staining and color change was also found to be 4 (slightly) in dry crocking as compared to wet crocking fastness scored 3-2 (noticeable-considerable).

After treatment of selected printed samples

Optimization of vinegar concentration for selected printed samples

Vinegar with various concentrations i.e. 5%, 10% and 15% were taken separately for after treatment of 3g reactive dye printed samples. The treated samples were subjected to physical and color fastness testing and also evaluated visually to select the best vinegar concentration of 3g reactive dye. The results are reported in table 4 and 5 and printed samples shown in sample sheet 4.

Physical properties of treated samples

All the treated cotton printed samples were subjected to physical properties testing such as thickness, bending length, crease recovery and drape test, the results are reported in Table 4.

According to table 4 the thickness of treated samples using vinegar for reactive dyes showed same result in different vinegar concentration i.e. 0.32 mm. Bending length result of treated reactive dye printed samples showedfrom 3.2 cm to 4 cm in warp direction and 3.6 cm to 4.3 cm in weft direction. The treated samples in both warp and weft direction showed increase in bending length with increase of vinegar concentration.

From the table it was observed that the treated samples printed with reactive dye showed 104˚ to 97˚ crease recovery angle in warp direction and 102˚ to 95˚ crease recovery angle in weft direction. Comparing all the results, it is concluded that higher the vinegar concentration lower will be the crease recovery angle and the printed samples become stiff. From the table 4, it is clear that there is no difference in values for vinegar in various concentrations of treated printed samples. Treated samples printed with reactive dye scored 0.23 to 0.22 in different vinegar concentration. Table also showed that treated printed samples with the increase of vinegar concentrations the drape coefficient of the fabric decreased and the fabric became softer.

Table 4: Drape, thickness, bending length and crease recovery of printed cotton fabric treated with different vinegar concentrations

Thickener used	Dye used	Vinegar concentration (%)	Drape coefficient	Thickness(mm)	Bending length (cm)		Crease recovery	
					warp	weft	warp	weft
Aloe Vera gel	4gReactive	5	.23	.32	3.2	3.6	104˚	102˚
		10*	.22	.32	3.8	3.8	101˚	98˚
		15	.22	.32	4	4.3	97˚	95˚

* Selected concentration

Color fastness properties of treated printed samples

All the treated printed samples were subjected to various color fastness testing such as light, washing, perspiration and crocking and the results are reported in table 5.

The results of light fastness of treated printed samples are shown in table 5. It is evident from the table that sunlight fastness of reactive dye treated printed samples showed outstanding light fastness i.e. (8). Color fastness to washing for reactive dye showed noticeable stained (3) in color staining, but change in color showed slightly change (4). According to table 5, in treated reactive dye printed samples color change was found to fluctuate between 3 and 4 (noticeable to slightly changed) in both acidic and alkaline perspiration solution.

According to table 5, the reactive dye treated samples in dry crocking the value ranged from 3 to 5 (noticeable to negligible) in color change and color stain whereas in wet crocking fastness rating ranged from 2 to 3.

Table 5: Light, washing, perspiration and crocking fastness of after treated cotton printed samples

Thickenerused	Dyeused (g)	Vinegar concentration (g)	Light fastness	Washing fastness		Perspiration fastness				Crocking fastness			
						Acidic		Alkaline		Dry		Wet	
				CC	CS	CC	CS	CC	CS	CC	CS	CC	CS
Aloevera gel	4g reactive dye	5	8	4	3	3	3	3	3	3	3	2	2
		10*	8	4	3	4	3	4	3	4	4	3	3
		15	8	4	3	3	3	4	4	5	5	3	3

CC - Change in color, CS – Color staining, *Selected concentration

Visual evaluation of after treated printed samples

All the treated samples were also subjected to visual evaluation by a panel of 20 judges including staff members and students and the results are reported in table 6. On the basis of results obtained through physical testing, colorfastness and visual evaluation, 10% vinegar concentration for 3g reactive dye was selected.

Statistical analysis also revealed that there is no significant difference, due to vinegar concentration, since the calculated value off at 5% d.f. is smaller than the tabulated value of f.

Table 6: Visual evaluation score of treated samples

Thickener used	Dye used	Vinegar concentration (%)	Average score
Aloevera Gel	4gReactive dye	5	4.2
		10*	4.5
		15	3.9

Maximum score – 5

Optimization of time period of selected after treated samples

Vinegar with 10% concentration in 3g reactive dye printed sample was taken separately for after treatment in different time periods i.e. 5 min, 10 min and 15 min. The treated samples in different time period were subjected to physical testing, color fastness testing and also evaluated visually to select the best after treatment time of 3g reactive dye. The results are reported in table 7 and 8 and printed samples shown in sample sheet 6.

Physical properties of treated samples with different time period

All the samples of cotton fabric were subjected to physical properties testing such as thickness, bending length, crease recovery and drape test, the results are reported in Table 7.

The thickness of selected treated samples with different time period using vinegar for reactive dye showed constant result showed 0.32 mm. It is evident from the table 7, that the selected treated reactive dye printed samples with different time period showed the value ranges from 3.8 cm to 3.9 cm in warp direction and 3.8 cm to 4.1cm in weft direction.

From the table that all the samples treated with vinegar in different time period showed high crease recovery in warp direction as compared to weft direction. It was observed that reactive dye printed samples treated with 10% vinegar in different time period showed 101˚ to 96˚ crease recovery angle in warp direction and 98˚ to 95˚ crease recovery angle in weft direction. From the table 7, it is clear that reactive dye showed drape coefficient value 0.23 in all time periods.

Table 7: Drape, thickness, bending length and crease recovery of after treated cotton printed samples with different time period

Thickenerused	Dyeused	Vinegar concentration (%)	Time period (min)	Drape coefficient	Thickness(mm)	Bendinglength (cm)		Creaserecovery	
						warp	weft	warp	weft
Aloevera gel	4gReactive dye	10	5*	0.22	0.32	3.8	3.8	101˚	98˚
			10	0.22	0.32	3.6	3.8	98˚	96˚
			15	0.22	0.32	3.9	4.1	96˚	95˚

* Selected concentration

Color fastness properties of treated printed samples with different time period

All the treated printed samples were subjected to various color fastness testing such as light, washing, perspiration and crocking and the results are reported in table 8.

The results of light fastness of treated printed samples with different time periods are shown in table 8. It is evident from the table that sunlight fastness of reactive dye treated printed samples in different time periods showed outstanding light fastness i.e. (8). From the table 8, color fastness to washing for reactive dye vinegar treated samples with different time periods showed noticeable stained (3) in color staining, but change in color showed slightly changed (4).

Table 8: Light, washing, perspiration and crocking fastness of after treated cotton printed samples with different time period

Thickener used	Dye used (g)	Vinegar concentration (g)	Time Period(min)	Light fastness	Washing fastness		Perspiration fastness				Crocking fastness			
							Acidic		Alkaline		Dry		Wet	
					CC	CS	CC	CS	CC	CS	CC	CS	CC	CS
Aloevera gel	4g Reactive	10	5*	8	4	3	4	3	4	3	4	4	3	3
			10	8	4	3	4	3	4	3	4	4	3	3
			15	8	4	3	4	3	4	3	4	4	3	3

CC - Change in color, CS – Color staining, * Selected concentration

For the table 8, reactive dye treated printed samples in different time period color change was found that 4 (slightly changed) in both acidic and alkaline perspiration solution. Perspiration fastness to color staining for treated reactive dye printed samples in different time period color staining showed 3 (noticeable stained) in acidic perspiration solution and 3 (noticeable) in alkaline perspiration solution. The reactive dye treated samples in different time period dry crocking showed 4 (slightly) in color change and color stain where as in wet crocking fastness in different time period showed 3 (noticeable).

Visual evaluation of after treated printed samples in different time period

All the treated samples with different time periods were also subjected to visual evaluation by a panel of 20 judges including staff members and students and the results are reported in table 9. It is evident from the table that the maximum average for 3g reactive dye with 10% vinegar concentration maximum average was scored by 5 min time period.

On the basis of results obtained through physical testing and visual evaluation, 3g reactive dye printed samples treated with 10% vinegar in 5 min time period were selected.

Table 9: Visual evaluation score of treated samples in different time period

Thickener used	Dye used	Vinegar concentration (%)	Time period(min)	Average score
Aloe Vera gel	Reactive dye (4 g)	10 (o.w.f.)	5*	4.8
			10	3.6
			15	4.4

Maximum score – 5

Product development

Total 2 final products were prepared by using optimized printing recipes. 2 apparel items, such as Kurti (Plate 1) and Skirt (Plate 2), were constructed.

Plate 1: Prepared Skirt using optimized recipe

Plate 2: Prepared Kurti using optimized recipe

Cost determination of final articles

The result of cost determination for cotton printed articles such as Kurti and Skirt is reported in table 10. According to table 10, the costs of the printed articles are ₹ 332.12 to ₹ 250.80.

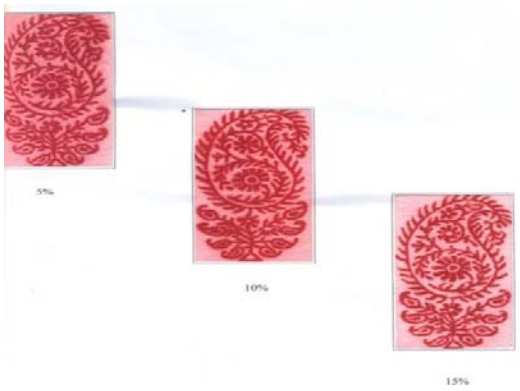
Table 2: Cost of printed articles

S.No.	Raw material used	Skirt		Kurti	
		Consum-ption	Total Cost (₹)	Consum-ption	Total Cost (₹)
1	Cotton fabric	3 ½ m	175	2m	120
2	Velvet fabric	1/2m			
3	Thickener	100g	70		
4	Dyes	R.D.- 8 g	15	50 g	7.5
5	Screen	¼m	12	R.D.-4 g	6
6	Chemicals	17g	50	¼ m	50
7	Vinegar	100 ml	40	8.5g	20
Labour charge		30			50
Actual amount		265.7			200.7
Profit (25%) margin		66.42			50.10
Sale price		332.12			250.80

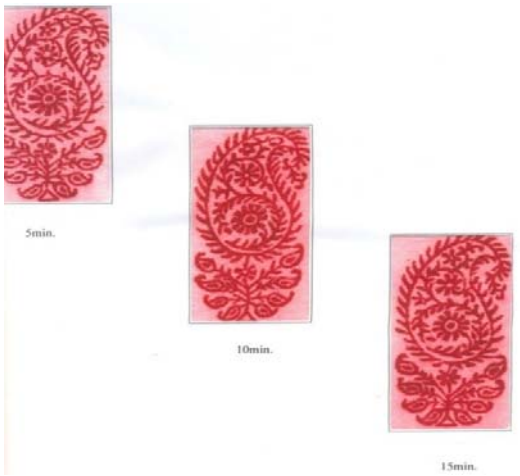
Conclusion

It is concluded that aloevera thickener with 4g reactive dye gave best results. In case of reactive dye after treatment with 10% vinegar for 5minutes gave best result. Physical properties, drape, crease recovery, thickness, stiffness of all printed and treated samples showed good results. Color fastness properties were also found to be satisfactory. All the articles printed and treated with optimized recipes were highly appreciated as these were cost effective. The cost of prepared products varying from ₹ 332.12 to ₹ 250.80.

Sample Sheet 1: Cotton samples printed with reactive dye in different concentrations using aloe Vera gel



Sample Sheet 2: Printed samples after treatment with vinegar in different concentrations



Sample Sheet 3: Printed samples after treatment with vinegar with different time period

References

1. Arun N. Modern trend in printing, Textile industry and trade journal, 2001, 44-45.
2. El-Zairy. E.M.R New thickening agent based on aloe Vera gel for disperse printing of polyester, Research Journal.2011; 11(2):66-67.
3. Kesarwani P, Singh A. Cotton fabric printing with reactive dye using guar gum, The Indian Textile Journalwww.indiantextilejournal.com, 2009.
4. Lal Sanganeri. Bagroo prints, Colourage1994; 107(6):18-12.
5. Naik SD, Wilson JA. Surface designing of textile fabrics, new age international publishiers, 2006, 37-43.
6. Rao JV. Printing, Gaps, 1st edition, Northern India Textile Research Association (NITRA), 2008, 7.
7. Shenai VA. Terminology of Textile Processing Technology of Printing, 1st edition, Sevak Publication, Bombay, 2003, 216-157.
8. Vatsala R. Text book of textiles and clothing, Publication of agriculture, ICAR, Krishianusandhan Bhavan 1, New Delhi, 2003, 141-142.