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Utilization of natural dyes for development of value added products

[1] Saroj Yadav, [2] Geeta Gaba

[1] Asstt. Scientist, Dept. of TAD, IC College of Home Science, CCSHAU, Hisar, Haryana, India
[2] Research Associate, Dept. of TAD, IC College of Home Science, CCSHAU, Hisar, Haryana, India

Abstract
Natural dyes were the main source of textile colouration until the invention of synthetic dyes in 1856. The easy technique of dyeing and reproducibility of shades with synthetic dyes put the natural dyes in oblivion. But with the consumers' enhanced awareness of eco-safety, once again there has been an increasing demand for products dyed and printed with natural dyes as these are considered environment friendly. In recent years, the textile industry has given considerable attention to the products prepared from natural dyes. Based on biocompatibility, biodegradability, non-toxicity, UV protection, and antimicrobial activity natural dyes are gaining popularity all around the world for producing more appealing and highly functional value-added textiles. This study aims at preparation of value added screen printed tablemats and to evaluate their market potential. *Khaddar* casement fabric in Beige colour was used for preparation of screen printed tablemats using *Kachnar* bark dye and *Cassia tora* gum. Designs were collected from secondary sources and five designs were selected according to the product and printing technique. Selected designs were refined in Corel DRAW software. Selected designs were placed in three different ways on tablemats and total fifteen placements were prepared and five placements were selected for preparation of products. The printed products were further embellished with hand embroidery, machine embroidery and fabric painting. The developed products were assessed for their design, placement of design and embellishment technique. Results of the study revealed that the developed products were highly appreciated by the consumers in terms of selection and placement of designs, printing and surface enrichment techniques used. Cost of the products was assessed as appropriate by majority of the respondents.

Keywords: Screen printing, Natural dye, Tablemats, Design, Placements, Value addition, Assessment

1. Introduction
The art of dyeing and printing of textiles dates back to the Indus Valley civilization and the archaeological evidence shows that in India dyeing has been widely carried out for over 5,000 years. The dyes were obtained from animal, vegetable or mineral origin, with none to very little processing. The embellishment of fabric with design and colour is a form of artistic expression that gives pleasure (Phadke and Sharma, 1993). The decoration of textiles may be achieved by colour through dyeing or creating designs by printing (Aggarwal, 2002) [1]. Probably the first addition of colour to fabric was made by printing designs on cloth. Printed fabrics are defined as fabrics decorated by motif, pattern or design (Marjory,1972).

Throughout history, people have dyed their textiles using the common and locally available materials. Scarce dyestuffs that produced brilliant and permanent colors such as the natural invertebrate dyes tyrian purple and crimson kermes were highly prized luxury items in the ancient and medieval world. By far the greatest source of dyes has been from the plant kingdom, notably roots, berries, bark, leaves and wood, but only a few have ever been used on a commercial scale.

The discovery of man-made synthetic dyes late in the 19th century ended the large-scale market for natural dyes. But with increasing awareness of people about harmful effects of synthetic dyes, stringent environmental standards imposed by many countries in a response to the toxic and allergic reactions associated with synthetic dyes, use of natural dyes for dyeing and printing of textiles is gaining momentum. However natural dyes have also some drawbacks; during the process generally a mordant which is usually a salt of metal ions are needed. In addition to this, its fastnesses especially light fastnesses are not very well but still the natural dyes are preferred in special goods and carpets. The green minded and consumers are en.wikipedia.org/wiki/Dye

It is not common to use natural dyes commercially now but at least in some special goods it is saving its popularities too. On the other hand, it can be foreseen that the demand for the ecological, natural and organic textile products will make natural dyes popular again. Owing to this, it is important to continue the studies on the usability of natural dyes in textile colouration techniques. Although dyeing with natural dyes has widespread in scientific researches, researches on the printing via natural dyes is limited. If there has been significant research on the development of printed fabrics with the natural dyes, it is possible that market for products prepared with natural dyes will increase. Hence a study was conducted to prepare products using natural dye and thickener and assess their market potential.

2. Methodology
Collection and selection of designs
For collection of designs books, journals, photographs and internet etc. were explored and sixty designs were collected keeping in mind the suitability of designs for the product as well printing technique i.e. screen printing. In order to know the preferences of experts for selected designs their opinion was sought on three point continuum scale i.e. highly preferred, preferred and least preferred. Weighted mean scores were calculated and ranks were assigned on the basis of

weighted mean scores. On the basis of the ranks, top ranked five designs were selected and were used for further work.

Refinement of designs
To get the required intricacy and fineness, selected designs were refined/ recreated in Corel DRAW software.

Preparation of placements
Fifteen design placements i.e. three placements of each design were developed using five selected designs with the help of Corel DRAW software.

Selection of placements
The prepared design placements were got evaluated from a panel of thirty experts and preferences were sought on three point continuum scale i.e. highly preferred, preferred and least preferred. Weighted mean scores were calculated and on the basis of weighted mean scores, ranks were assigned to each placement. The placement which secured rank I for each design was selected for further work, hence total of five placements were selected.

Preparation of screens
Screens of selected five design placements were got prepared.

Selection of Dye and thickener
On the basis of results of printing of cotton with *Kachnar* bark using *Cassia tora* gum (2014-15), *kachnar (Bauhinia variegate)* bark dye was selected for preparation of file folders through screen printing technique. *Cassia tora* gum was used as thickener for printing.

Selection of Fabric
Khaddar casement fabric in Beige colour was selected for preparation of products.

Printing of products
Screen printing was done as per the standardized procedure and total twenty tablemats were printed for further work.

Value addition of printed products
Three surface enrichment techniques i.e. hand embroidery, machine embroidery and fabric painting were used for value addition of printed products. Products of each design were enriched with selected techniques and one sample was kept as control i.e. printing only.

Calculation and assessment of cost of developed products
Cost of developed products was calculated on the basis of cost of raw material, embellishment charges and finishing charges. Cost of prepared articles was got assessed from thirty respondents whether appropriate, high or low. Frequencies and percentages were calculated to draw the inferences.

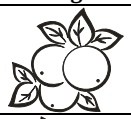
Assessment of developed products
The developed products were exhibited in well lightened lab. of Department of Textile and Apparel Designing, I.C. College of Home Science, CCSHAU, Hisar and got assessed from thirty respondents comprising of faculty members and PG students of I.C. College of Home Science, CCS Haryana Agricultural University, Hisar on the basis of designing parameters and overall appearance. The opinion of the consumers regarding developed products was sought using self-developed opinion scale. All features were assessed using three point rating scale.

3. Results and Discussion

3.1 Collection and selection of designs for file folders

Total sixty designs were collected from secondary sources like books, journals and internet etc., keeping in mind their suitability for screen printing on tablemats. The collected designs were shown to experts for selection of designs for screen printing on tablemats. Out of collected sixty designs, five designs were selected on the basis of experts' preferences. As per the preferences of experts design number 37 was ranked I scoring 2.93 followed by design number 27 (2.92) ranked II, design number 15 (2.90) ranked III, design number 13 (2.87) ranked IV and design number 12 (2.86) ranked V. It is thus inferred that the preferred designs used for screen printing on file folders were design number 12, 13, 15, 27 and 37.

Table 1: Selected Designs for Placement on Tablemats

Design No.	Designs	Weighted Mean Score	Rank
12		2.86	V
13		2.87	IV
15		2.90	III
27		2.92	II
37		2.93	I

3.2 Placement of selected designs on file folders

This section includes preferential choices of respondents for placements of selected five designs on tablemats. Total fifteen placements were made by placing selected five designs in three different ways on tablemats. The data related to preferential choices of experts for placement of designs are presented in Table 1.

Table 2: Preferences for placements of selected designs on file folders and tablemats (n=30)

	Placements		
Design No.	I (WMS)	II (WMS)	III (WMS)
12	2.72	2.73	2.79
13	2.70	2.75	2.83
15	2.80	2.75	2.73
27	2.90	2.80	2.82
37	2.70	2.85	2.73

WMS= Weighted Mean Score

Regarding preferences of experts for placements of designs on tablemats the data revealed that Design number 12 and 13 were favoured most by the experts in placement III scoring 2.79 and 2.83, respectively. Design number 15 and 27 with placement I were preferred the most scoring 2.80 and 2.90, respectively. The most preferred placement for Design number 37 was placement II scoring highest mean score 2.85 (Table 2).

Selected Placements for Tablemats

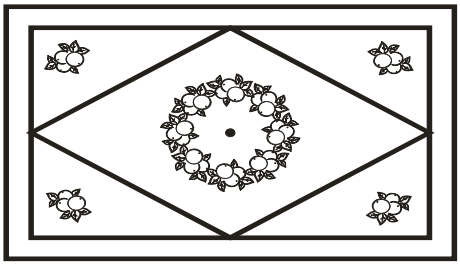


Fig 1: Design No.12

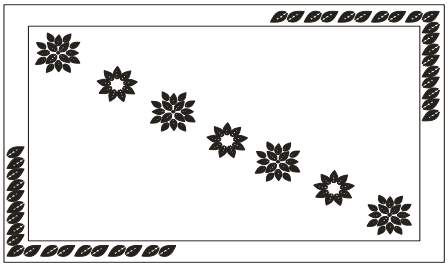


Fig 2: Design No.13

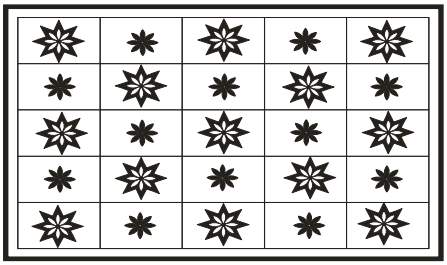


Fig 3: Design No.15

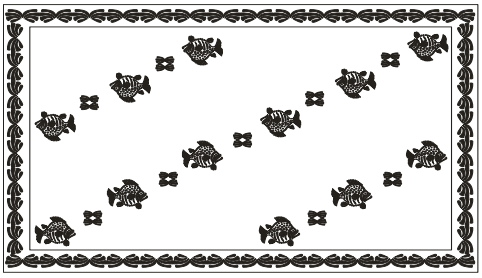


Fig 4: Design No.27

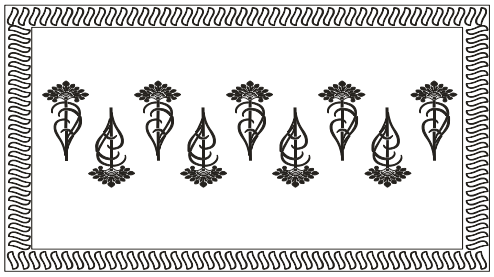


Fig 5: Design No. 37

3.3 Development of tablemats

A total of twenty tablemats were developed through screen printing technique using selected designs and their placements. The printed articles were further embellished with hand embroidery, machine embroidery and fabric painting.

3.4 Determination of the cost of developed products

The cost of prepared products was calculated on the basis of expenses incurred on raw material, embellishment charges and finishing charges.

The data presented in Table 3 depicted that total cost of tablemats prepared with only printing technique was Rs. 65/- whereas cost of tablemats embellished with hand embroidery was from Rs. 75 to 80/-. The cost of tablemats embellished with machine embroidery was from Rs. 80 to 95/- and with fabric painting cost was Rs.75/-.

Table 3: Cost of developed tablemats

Developed Table Mats		Cost Parameters (Rs.*)			
		Raw Material	Embellishment Charges	Finishing Charges	Total
Design 12	A	35	---	30	65x6=390
	B	35	15	30	80x6=480
	C	35	30	30	95x6=570
	D	35	10	30	75x6=450
Design 13	A	35	--	30	65x6=390
	B	35	10	30	75x6=450
	C	35	15	30	80x6=480
	D	35	10	30	75x6=450
Design 15	A	35	---	30	65x6=390
	B	35	15	30	80x6=480
	C	35	20	30	95x6=570
	D	35	10	30	75x6=450
Design 27	A	35	---	30	65x6=390
	B	35	10	30	75x6=450
	C	35	30	30	95x6=570
	D	35	10	30	75x6=450
Design 37	A	35	---	30	65x6=300
	B	35	15	30	80x6=480
	C	35	30	30	95x6=570
	D	35	10	30	75x6=450

A= Printing Only, B= Printing+ Hand Embroidery, C= Printing + Machine Embroidery, D= Printing+ Fabric Painting

3.5 Consumers' opinion regarding the cost of developed tablematsThe developed file folders were got assessed by the consumers for the cost whether high, appropriate or low and data have been presented in Table 4.

The data in Table 4 revealed that almost all the consumers rated cost as appropriate for developed tablemats and only a few respondents rated the cost as high i.e. 10.00 percent for design number 12 embellished with hand and machine embroidery, 13.33 percent for design number 15 embellished with machine embroidery, 16.67 percent for design number 27 embellished with machine embroidery and 10.00 percent for design number 37 embellished with fabric painting.

Table 4: Consumers' opinion regarding the cost of developed tablemats (n=30)

Developed Tablemats		Total Cost (Rs.)	Opinion Regarding Cost			
			Appropriate		High	
			Frequency	Percentage	Frequency	Percentage
Design 12	A	65x6=390	30	100.00	---	---
	B	80x6=480	30	97.00	03	10.00
	C	95x6=570	27	97.00	03	10.00
	D	75x6=450	30	100.00	---	---
Design 13	A	65x6=390	30	100.00	---	---
	B	80x6=480	30	100.00	---	---
	C	95x6=570	30	100.00	---	---
	D	75x6=450	30	100.00	---	---
Design 15	A	65x6=390	30	100.00	---	---
	B	75x6=450	30	100.00	---	---
	C	95x6=570	26	86.66	04	13.33
	D	75x6=450	30	100.00	---	---
Design 27	A	65x6=390	30	100.00	---	---
	B	75x6=450	30	100.00	---	---
	C	80x6=480	25	83.33	05	16.67
	D	75x6=450	30	100.00	---	---
Design 37	A	65x6=300	30	100.00	---	---
	B	80x6=480	30	100.00	---	---
	C	95x6=570	30	100.00	---	---
	D	75x6=450	27	90.00	03	10.00

A= Printing Only, B= Printing+ Hand Embroidery, C= Printing + Machine Embroidery, D= Printing+ Fabric Painting

3.6 Assessment of Products

The developed products were got assessed for designing parameters i.e. designs used and placement of designs and suitability of surface enrichment techniques. The data related to assessment of developed products is presented in Table 5 and 6.

A. Designing Parameters

- **Designs:** The data elucidate that design number 13 and 37 were found most appealing scoring highest i.e. 2.73 each, followed by design number 15 (2.60), design number 27 (2.53) and least appealing was design number 12 (2.46).
- **Placements of designs:** Placement of design number 15 (2.73) was found most appealing and, followed by design number 37 (2.70), design number 27 (2.67) whereas placement of design number 12 and13 were least preferred scoring 2.60 each.
- **Overall:** On the basis of average mean scores overall tablemat of design number 37 was found most appealing scoring 2.71 and ranked I, followed by design number 13 and 15scoring 2.66 each and ranked II, design number 27 (2.62) ranked IV and design number 12 (2.53) was ranked V.

Table 5: Assessment of developed products on designing parameters (n=30)

Table mats				
Design No.	Designing Parameters		Over all	
	Designs	Placement of Design		
	WMS	WMS	AMS	Rank
12	2.46	2.60	2.53	V
13	2.73	2.60	2.66	II
15	2.60	2.73	2.66	II
27	2.53	2.67	2.62	IV
37	2.73	2.70	**2.71**	I

WMS- Weighted Mean Score AMS- Average Mean Score

Table 6: Assessment of developed products for surface enrichment techniques (n=30)

Design No.	Printing Only (A)		Surface Enrichment Techniques					
			Printing + Hand Embroidery (B)		Printing + Machine Embroidery (C)		Printing + Fabric Painting (D)	
	WMS	Rank	WMS	Rank	WMS	Rank	WMS	Rank
12	2.53	I	2.40	II	2.20	III	1.93	IV
13	2.20	II	2.33	I	2.13	III	1.80	IV
15	2.53	I	2.40	II	2.20	III	1.93	IV
27	2.13	III	2.40	I	2.26	II	2.00	IV
37	2.27	I	2.33	II	2.00	III	1.67	IV
	Average Mean Score 2.33		Average Mean Score 2.37		Average Mean Score 2.15		Average Mean Score 1.86	

B. Surface Enrichment Techniques

The screen printed tablemats of each design were enriched with three techniques i.e. hand embroidery, machine embroidery and fabric painting. The data pertaining to opinion of consumers regarding embellishment techniques is presented in Table 6.

The data revealed that developed tablemats of design number 12, 15 and 37 were most preferred for printing only i.e. without embellishment scoring 2.53 and 2.27, respectively. Tablemats of design number 13 and 27 were most preferred with hand embroidery scoring 2.33 and 2.40, respectively. Tablemats embellished with machine embroidery and fabric painting were ranked III and IV.

On the basis of average mean scores tablemats embellished with hand embroidery were preferred most scoring highest i.e. 2.37, followed by printing only (2.33), machine embroidery (2.15) and least preferred was fabric painting (1.86).

Table 7: Opinion of the consumers regarding developed products (n=30)

Statements	Developed file folders (WMS)				
	Design 12 (WMS)	**Design 13 (WMS)**	**Design 15 (WMS)**	**Design 27 (WMS)**	**Design 37 (WMS)**
The screen printed file tablemats are attractive and unique	2.83	2.83	2.73	2.51	2.53
Screen printing technique is innovative and as per fashion trend	2.63	2.70	2.53	2.62	2.45
Colour combinations of embellishment technique used with base colour is appealing	2.60	2.50	2.46	2.38	2.36
Embellishment enhanced the effect of printing	2.72	2.67	2.57	2.53	2.68
The developed tablemats are acceptable as per market trend	2.70	2.68	2.62	2.57	2.62
The developed products will have high marketability.	2.60	2.45	2.65	2.62	2.58
Average Mean score	2.68	2.63	2.59	2.53	2.53

WMS- weighted mean score strongly agree: 3.00-2.33, Agree: 2.33-1.66, Somewhat Agree: 1.66-1.00

It is inferred from data in Table 7 that the consumers had very high opinion about the developed products in relation to the 'screen printing technique used is attractive and unique', 'screen printing technique is innovative and as per trend', 'colour combinations of embellishment technique used with base colour is appealing', 'embellishment enhanced the printing effect', the 'developed products are acceptable as per trend' and the 'products will have high marketability'.

4. Conclusion

The developed products were highly appreciated by the respondents in terms of selection and placement of designs, printing and surface enrichment techniques used. Cost of the products was assessed as appropriate by all the respondents. Printing embellished with hand embroidery was most preferred. The developed products will have high marketability.

5. References

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