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Formulation of Eco Friendly Print Paste for Block Printing By Natural Gum Extracted From Mango Kernel and Cassia Tora Seed with Indigo Dye

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Abstract: The present investigation was under taken to investigate the possibility to using natural gum extracted from Mango kernel and Cassia seed for block printing on Cotton fabric. These two sources of natural gum are cheap and indigenous. The print quality was assessed by visual examination and by colour fastness test. Experimental observation showed that both the gum can be successfully used for textile printing on cotton fabric as indigenous and natural thickener which is friendly to environment.

Keywords: Natural printing, Indigo dyes, Colour fastness, Natural gum.

INTRODUCTION

Natural dyes have the ability to produce wide range of tints and shades, with the same dye material. But the invention of synthetic dyes in 1856, the prominence of natural dyes slacked because of synthetic dyes had some advantages over natural dyes like colour fastness, good reproducibility of shades, brilliance of colour and easy to use. It has been found with the time that synthetic colours not only often are harmful to health but also result in the cause of pollution for eco system Acquaviva et al.; Zheng et al. [1, 2]. These drawbacks about using synthetic dyes due to involvement of highly toxic and carcinogenic effluents in

waste water during processing has expelled them for dye-housed[3]. Hence ban has been imposed by Germany and some European country. Many plant which extracted dyes have antioxidant, antimicrobial properties are used in various walks of life, well known for their health curing characterization. Studies on their characterization are also going on the way Farizadeh et al.; Adeel et al.; Adeel et al. [4, 5, 6].

Solid agri-food waste materials cause serious environmental problems such as water pollutions, unpleasant odour, explosions and combustion, asphyxiation, vegetation damage and greenhouse gas emission Zamarana& et al[7].Consequently there is a considerable emphasis on the recovery, recycling and upgrading of agricultural waste as low cost source**.**

Cassia is used as tonic, carminative and stimulant. Cassia contains 1-2 % volatile cassia oil which is mainly responsible for the spicy aroma and taste. The primary chemical constituents of Cassia include cinnamaldehyde, gum, tannins, mannitol, coumarins and essential oils (aldehydes, eugenol, and pinene); it also contains sugars, resins and mucilage among other constituents http://www.agrogums.com/&Kritikar, Basu[8],Seed gums are important agrochemical used in various industries worldwide. The growing industrial utility of these gums in the field of paper, textile, petroleum recovery and pharmaceutical industries has resulted in an impetus in India for intensified research on new sources of gums and their modified products. Cassia toramucilage (CTM) derived from the seeds of Cassia toraLinn.

Mango (Mangiferaindica L.) is one of the most favored and commercially valuable fruit growing throughout the tropics and is used in a variety of food products. Considerable amounts of mango kernels (seeds) are discarded as waste after industrial processing of man-goes Puravankara, Bohgra, & Sharma[9].The molecular weight of the mango kernel starches is lower whereas the amylose content and crystallinity were higher than that of normal corn starch. The mango kernel starches contained higher resistant starch leading to lower glycemic index values compared to normal corn starch. Therefore, mango kernels wasted after industrial processing of mango could become a useful source of starch, especially in terms of its beneficial digestibility behavior and high RS content. Singh, Sidhu, Lim[10] Due to the eco-consciousness, the researcher's attention has been shifted to the use of natural products for printing The present paper deals with preparation of thickening agent from Cassia seed gum and Mango kernel gum and investigating of their suitability as thickening agent in block printing on cotton fabric using indigo dye extract with two different mordants and testing its CIE Colour coordinates and colour fastness properties.

MATERIAL AND METHOD

Fabric & Pretreatment of fabric: Plain white grey fabric was purchased from market. Desizing was done in order to remove the impurities from the fabric. Fabric was boiled for 45 min. in a solution containing 2grams of nonionic detergent and one gram of NaOH per liter of water. After this by kneading and squeezing the samples were rinsed in tap water and sun dried.

The fabric was pretreated with 20 percent of *myrobalan* solution for 24 hours maintaining the 1:20 MLR (material to liquor ratio) the fabric was squeezed in both warp and weft direction and sun dried. The side exposed to sunlight was darker and was used for printing.

Dyes & Mardants used: Indigo dyes, copper sulphate and ferrous sulphate mordant were used.

Preparation of printing paste & Printing:

Indigo dyes - 2%

Thickener -2.5 gm soaked in 10-15 ml luke warm water

Mordant -3%

Water – 70-90ml

All ingredients were mixed together and boiled until required consistency was obtained. The printing paste was applied to the fabric through block printing technique. After printing samples were treated with Alum. Fixation of all the printed goods was done by steaming at125^{o}for30 min.

Measurement of fastness properties: Colour fastness test to light, washing crocking or rubbing was carried out in Fad-o-meter, launder-o-meter and crock-o-meter respectively and fastness was rating were given in Grey scale AATCC Technical Manual[11].

CIE lab Coordinator: The CIE coordinator L*, a* and b* of the sample printed were evaluated. The higher values of a* and b* indicate brightness, which is more due to redness and yellowness, respectively and negative value indicate greenness and blueness, which are more duller shades. The lower value of L* indicates the greater the depth of colour.

Block printed Samples with indigo dye		
Mordant conc. (%)	Mango Kernel Gum	Cassia Tora Seed Gum
Copper sulphate		
Ferrous sulphate		

RESULTS AND DISCUSSION

In order to compare the effect of two thickening agent .Cotton fabric was printed with natural dye extracted from Indigo with two different mordant. The CIE values and their corresponding fastness properties were evaluated. The natural colourants are considered as non-carcinogenic, easily biodegradable and nontoxic for human health Ghoulia et al., [12].

Evaluation of colour coordinates of printed sample. The colour values of the printed fabric using different mordant and thickening agent are summarized in Table-1.When the printing was carried out without any mordant, the print obtained were light in shade and colour bled heavily after washing however the *myrobalan* pretreated samples were printed it give deeper and faster print. In case of copper sulphate/ ferrous sulphate the colour value were higher. The varying combination of mordant resulted in different shades and tones of printed fabric. This is evident from CIE colour co- coordinator result shown in table.

Table 1: Effect of thickening on colour strength of Block printed cotton fabric

Thickening agent	Mordant	CIE Colour Coordinates		
		L*	a*	b*
Mango Kernel Gum	Ferrous sulphate	66.85	-.82	22.95
	Copper sulphate	68.43	-1.37	20.25
Cassia Seed gum	Ferrous sulphate	68.35	-1.47	21.09
	Copper sulphate	72.30	-1.27	21.58

The printing obtained using Indigo dye in case of ferrous sulphate were more greenish (distinctly lower a* value for higher b* value) as compared to the respective printing, obtained using copper sulphate. In case of Mango kernel seed gum no distinct in tonal variation was observed. Higher L* values relates to increase in brightness Since L*values were more than 60 closer to 100 brightness of the shades was very good.

The a* values are negative and more than zero which shows greenish shades b* values were positive indicating bluish shade means the shade obtained in block printed sample is greenish blue. It is well known that the use of mordant is essential to fix most of the natural dye on the textile fabric. Dixit *et al.*[13].Colour fastness of dyed samples successfully improved with the use of mordants.

The Light Fastness: The fading of dyed or printed colours in light may be due to some kind of breakdown in the light energy absorption capacity of the electrons of the chromospheres or a breakdown in the structure of the dye molecule. When sunlight energy is absorbed, the loosely held electrons of the chromospheres are raised to a higher energy level that is, they become more active. It is known that ultraviolet component of sunlight will in time initiate chemical reaction. Such chemical reaction will be accelerated under moist conditions. Fading in sunlight is partly due to ultraviolet radiation that initiates chemical degradation of loosely held electrons of chromophores.

Fading of dyed or printed textile material does not occur so readily in artificial light, mainly incandescent and fluorescent light, as there light sources don't emit significant quantities of ultraviolet radiation. Data in table clearly reveals that there was increase in L* values and slight variation can be judged by CIE colour coordinates. Light fastness grades rating was 6 or 7 which indicates very good or best resistance towards light. Light fastness of printed fabric is influenced by chemical, physical state and concentration of dye, nature of the fibers and mordant type. Cristea and Vilarem[14].

Crocking Fastness: Crocking is the transfer of colour from a coloured textile to another fabric surface through the rubbing process. The extent of rubbing may be influence by the moisture, as many textiles

transfers more colour when wet. The test requires a crock meter & colour transfer is then evaluated using the standard chromatic transference scale or gray for staining. The rubbing fastness is assessed by two parameters which are dry and wet

Table2: CIE Colour Coordinates and Light Fastness Grades of Block Printed Cotton Fabric

Thickening agent	Mordant	Light fastness	CIE Colour Coordinates			Light fastness Grades
			L	a*	b*	
Mango Kernel Gum	Ferrous sulphate	Controlled	75.64	0,57	29.78	7
		Exposed	69.81	2.89	32.03	7
	Copper sulphate	Controlled	76.97	0.48	30.18	6
		Exposed	71.71	.807	28.46	6
Cassia Seed gum	Ferrous sulphate	Controlled	62.99	.249	20.80	6
		Exposed	66.16	-.21	22.47	6
	Copper sulphate	Controlled	75.33	0.27	24.56	7
		Exposed	70.44	-.22	21.39	7

(Rating 1-poor,2-fair,3-moderate,4-good,5-better,6-very good,7- best &8-excellent)

Dry: Rub the rubbing fabric with crock meter under pressure of 9N (400 p/cm2) (To and Fro) on the test sample of sized l0x 1" inch for ten times

Wet: Rub the rubbing fabric soaked with demineralized water (100% pick up) with the crock meter under a pressure of 9N (to and fro) on the test sample of 10 x 1 inch for ten times. Rubbing fastness grades in table is 5and4/5 for colour change. The colour fastness grades for colour staining ranged 4-5. CIE colour coordinate results also support the rubbing fastness grades.

Table 3: CIE Colour Coordinates and Rubbing Fastness Grades of Block Printed Cotton Fabric

Thickening agent	Mordant	Rubbing	CIE Colour Coordinates			Rubbing fastness grade	
			L	a*	b*	CC	CS
Mango Kernel Gum	Ferrous sulphate	Dry	55.89	-4.79	12.03	4	¾
		Wet	55.44	-3.39	10.01	4	4
	Copper sulphate	Dry	71.16	-2.13	19.580	4/5	4
		Wet	66.58	-0.62	22.08	4/5	4
Cassia Seed gum	Ferrous sulphate	Dry	75.11	-2.12	22.41	5	5
		Wet	64.11	-2.96	23.60	4/5	4
	Copper sulphate	Dry	66.12	-3.55	14.81	5	4
		Wet	61.17	-1.75	15.23	4/5	4

CC=Colour Change,CS - Colour staining,(Rating1-poor,2-fair,3-good,4-very good & 5-excellent)

Table 4: CIE Colour Coordinates &Washing Fastness Grades of Block Printed Cotton Fabric

Thickening agent	Mordant	CIE Colour Coordinates			Washing fastness grade		
		L	a*	b*	CC	CS	
						W	C
Mango Kernel Gum	Ferrous sulphate	47.25	-2.77	5.53	4	4/5	4/5
	Copper sulphate	55.41	-3.08	6.90	4	3/4	4/5
Cassia Seed gum	Ferrous sulphate	51.79	-3.0	7.44	4	4/5	4/5
	Copper sulphate	60.56	-3.19	10.05	4	4/5	4/5

CC=Colour Change, CS=Colour staining, W=wool,C=cotton

Washing fastness: Colour fastness to washing of the block printed samples was evaluated. A solution containing 5g/l soap solution was used as washing liquor. The sample was treated for 60 min at 50º C using liquor to material ratio 50:1 in launderometer. After rinsing and drying the change in the colour of samples were evaluated on the respective scale (rating 1-5 where 1-poor, 2-fair, 3-good, 4-very good, and 5-excellent. The washing fastness grades in the table shows very good to excellent wash fastness to nonionic soap. CIE colour coordinate data also support the wash fastness grades. Data in table 4 clearly reveals that there is decrease in L* value and b* values and increase in a* value which indicates that brightness of printed samples became slightly darker. Increase in a* value indicates increase in redness of printed samples.

Table 5: CIE Colour Coordinates and Prespireometer Grades of Block Printed Cotton Fabric

Thickening agent	**Mordant**	**CIE Colour Coordinates**			**Prespireometer grade**		
		L	**a***	**b***	**CC**	**CS**	
						W	**C**
Acidic Medium							
Mango Kernel Gum	Ferrous sulphate	49.53	3.81	22.06	Darker	4	4
	Copper sulphate	69.42	4.15	35.39	5	4/5	5
Cassia Seed gum	Ferrous sulphate	46.52	5.44	15.97	4	4	5
	Copper sulphate	72.38	0.69	28.40	4/5	4	4/5
Alkaline Medium							
Mango Kernel Gum	Ferrous sulphate	60.95	3.77	23.97	4	4	4/5
	Copper sulphate	54.66	2.10	29.59	5	5	4/5
Cassia Seed gum	Ferrous sulphate	68.35	-1.47	21.09	4/5	4	5
	Copper sulphate	64.91	-2.4	18.70	5	4	4

CC=Colour Change,CS - Colour staining, W=wool, C=cotton,

Perspiration fastness: When we compare the standard L* values from the table 1 to that of table 5 we came to know that almost all block printed cotton sample showed good performance during acidic and alkaline perspiration test as L* values shows slight variation during acidic and alkaline perspiration test, except ferrous sulphate treated mango kernel thickened block printed sample where L* value decreased. It means that shade became darker. Critical analysis of a* values revealed that a*value of standard sample was negative but in case of acidic medium both mordant printed sample a* value became positive which indicates increase in redness index, but in case of cassia seed printed sample in alkaline medium no change was observed and value remains the same. This result is also supported by Perspirometer grades where the colour becomes darker. Slight colour staining was observed. Colour of block printed fabric becomes lighter in case of alkaline medium with mango kernel gum, while shade becomes lighter with cassia seed gum in acidic medium. The good colour fastness properties might be attributed to benzene ring and conjugated system present in dye which make firm bonding with modified fabric upon exposure to agencies heat, light and rubbing resistance.Popoola[15].

CONCLUSION

Block printing carried our using gum extracted from cassia and mango kernel gave soft light and dark shades depending upon the mordants used. With regards to colour fastness test samples exhibited excellent to good fastness properties toward light, crocking, perspiration and washing. Therefore these thickening agents can successfully and effectively used to print the cottonfabric, so recommended to be used as thickening agent to textile industries institutions that deals with dyes, thickening agents. From this investigations it was revealed that the extract was good as thickening agent so can be accepted by printing industries as well as local printers and that these sources are available in abidance, therefore unemployed youths can have something to do, collect the sources, process and sale, consequently market business will be generated in this direction.

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