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EVALUATION OF COLOUR FASTNESS PROPERTIES OF MICROBIAL PIGMENT EXTRACT FROM NOVEL SOURCES FOR TEXTILE ECOFRIENDLY DYEING & STUDY OF CIE LAB COLOUR VALUE

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ABSTRACT: The pigment has acquired the greatest importance because of its excellent color value. The potential use of various carbon sources as microbial pigments for textile coloration. Flowers, leaves, fruits, vegetables, and tubers are the rich source of the secondary metabolites. In the current study, the use of microbial extract isolated from a fermentation process from 14 varieties by using *Penicillium purpurogenum* as a natural dye was studied. The potentiality of the dye extract was classified by dyeing with 100% cotton under suitable conditions. The dye ability, colorfastness (wash, light, rubbing) and Munsell color value, hue, L, a, b of dyed liquids were studied by using computer color matching software were studied. The color of the dye was not affected by washing. The results reveal that *Hibiscus rosa sinensis*, *Ixora coccinea* and *Nerium oleander* having highest K/S values. It could be seen that *P. purpurogenum* responded by producing high concentrations of pigment from *Tagetes patula* flower (crude) than the other combinations. It is to their ability for the formation of coordinate complexes with cotton material. In that view the ability of the pigment, it is a good application to the dyeing industry.

INTRODUCTION: The coloring is crude crafts-manship. It is the way toward adding shading to material items like filaments, yarns, and fabrics [1]. The coloring procedure incorporates adhering plants to texture or rubbing pounded shades to the material. This method becomes outdated over time and techniques were improved by using natural dyes from crushed fruits, vegetables and other plants. Later, a synthetic process of dyeing is in usage. There are various different mordant's were used for dyeing.

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Stringent is a compound substance which fixes shading to the texture. The superiority of the mordants utilized is man-made petrochemicals. The synthetic dyes are of chemical compounds that are harmful to humans, as well as those people who work in industries. The synthetic substances present in the colors are chromium, copper, lead, mercury, NaCl, toluene and C_6H_6 mixes. These are dangerous and effectively affect humankind. The microbial colors are acquired from different sources like animals, plants and microorganisms are nontoxic, less wellbeing hazardous [2] and gives a positive result. Microbial colors are more points of interest over the plant and animal-based colors. These can deliver countless, carotenoids, flavonoids, quinines and rubramines. The *Penicillium purpurogenum* strain contains several compounds that are identified as secondary metabolites [3].

These dyes are of good alternative dyes and require less production time. Likely, some of the fungal species *Monascus purpurus*, *Emmerciella* sp, *Penicillium* sp., *Fusarium* sp., *Themomyces* sp, *Aspergillus* sp, *etc.* are effective in production of pigments [4, 5, 6]. By minimizing the harmful chemicals used in dyes, the microbial dyes are discovered to replace the synthetic dyes. These are environment-friendly and green-minded.

In the current investigation, the color pigments are obtained from various flowers, fruit peels, vegetables, and tuber sprouts by using *Penicillium purpurogenum* strain through fermentative production.

MATERIALS AND METHODOLOGY:

Materials:

- **Flowers:** *Hibiscus rosa sinensis*, *Ixora coccinea*, *Gomphrena globosa*, *Tagetes patula*, and *Nerium oleander*.
- **Leaves:** *Moringa oleifera*, *Trigonella foenum-graecum* and *Spinacia oleracea* L.
- **Fruit Pulp and Peels:** *Citrus reticulata*, *Carica papaya* and *Citrus limon*.
- **Vegetables:** *Luffa acutangula* and *Solanum tuberosum*.
- Desired cotton and soap solution.
- *Penicillium purpurogenum* NCIM 713 from NCL Pune.

Methodology:

- **Fermentation Process:** The culture of the *Penicillium purpurogenum* was inoculated into corresponding materials mentioned above in the flask. The inoculated flask was incubated on a rotating shaker (200 rpm) at 25 ºC for 7 days. After incubation, the broth obtained was separated by filtration. The solution obtained was colorful and called the pigment or microbial dye. The solution is dried and utilized as a powdered dye.
- **Dyeing Process:** The dyeing process involves the following stages.

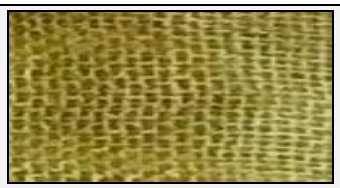
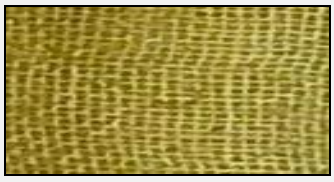
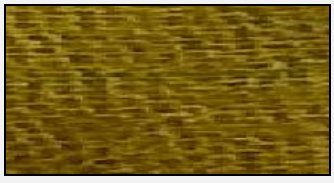
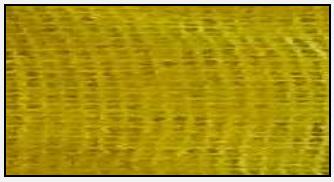
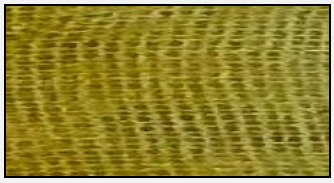
a) Scouring of Cotton: The cotton cloth was washed in a solution containing ionic detergent 2 g/l at 50 °C for 30 min. The scoured fabric was washed with faucet water altogether and dried at room temperature. It is prepared for the coloring process.

b) Dyeing: The cotton tarred into 14 sections was dyed with a coloured solution. The dye extract was prepared by adding 5 gm dye powder in 100 ml water (M:L = 1:50). After dyeing, the colored cloth was washed with water, dried at RT. The color strength was calculated spectrophoto-metrically by using Computer Colour Matching software at the maximum wavelength of the microbial colorant.

RESULTS AND DISCUSSION:

- **Dyeing:** The 100% cotton cloth is dyed with different microbial dyes under suitable conditions. The temperature is maintained at 40 °C and washed with water. Then, the dried cloth was tested for the following color parameters.

S. no.	Control	Dyed cotton	After washing	Sunlight
1	*Moringa oleifera*			
2	*Trigonella foenumgraecum*			

3	*Hibiscus rosa sinensis*			
4	*Ixora coccinea*			
5	*Gomphrena globosa*			
6	*Tagetes patula*			
7	*Nerium oleander*			
8	*Tagetes patula* + *Citrus reticulata*			
9	*Citrus reticulata* + *Carica papaya*			
10	*Tagetes patula* + *Carica papaya*			
11	*Spinacia oleracea L.* + *Tagetes patula*			
12	*Citrus limon* + *Carica papaya*			

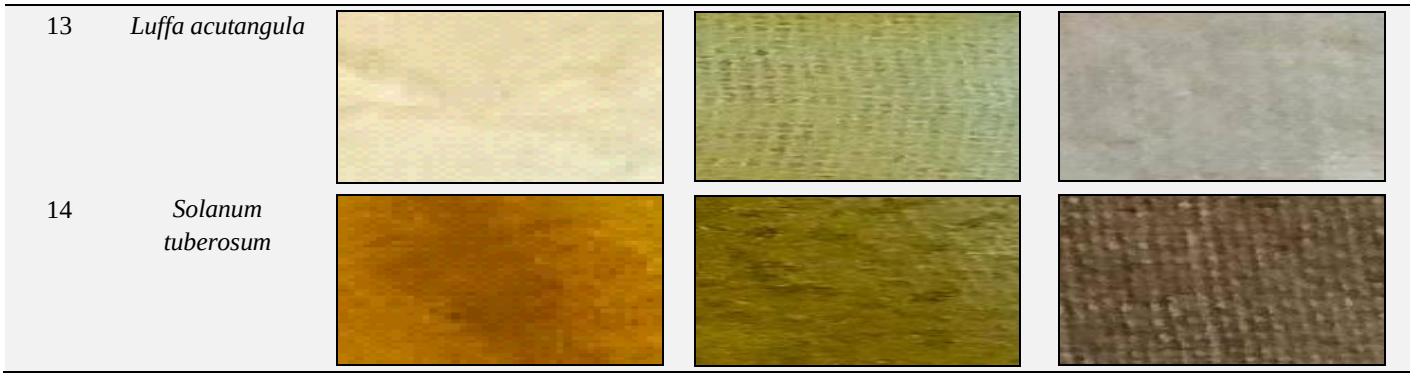


FIG. 1: IMAGES OF DYED, WASHED, RUBBED AND LIGHT FASTNESS OF COTTON CLOTH

Measuring Munsell Colour Value: In 1921, Albert Munsell system has explained the significance of color value with an image of a "color tree". Munsell value is calculated as luminance occurred white reflector, which is designed a Munsell color value of 10, while CIE lightness L* is calculated luminance occurred similarly standard white reflector, which is designed lightness of 100. Munsell color value 10 equals to 100 or slightly greater than 100. Based on the Munsell color value scale for painting classes7 and comparison of Munsell color value with CIE Lightness (L*) color value, the Munsell Values are calculated as follows.

TABLE 1: MUNSELL COLOUR VALUE

S. no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Picture Scans														
Munsell Value	6.55	7.67	12.4	13.01	7.34	7.81	0.89	7.34	7.22	7.56	7.25	7.45	8.74	6.34

TABLE 2: THE CIE VALUE L*, A*, B*, C, HUE AND K/S VALUES WITH COLOUR FASTNESS VALUES ARE TABULATED AS FOLLOWS

S. no.	Scientific name	Wash Fastness	Light Fastness	Rubbing Fastness	L*	a*	b*	C*	h^o Value	K/S Value
1	*Moringa oleifera*	3.5-4	III/IV	4	65.99	4.87	40.54	40.84	83.16	0.552
2	*Trigonella foenum graecum*	3	II	2/3	78.92	-0.33	18.98	18.98	91	0.3
3	*Hibiscus rosa sinensis*	4-5	IV	4/5	12.61	34.01	21.72	40.36	32.56	2.935
4	*Ixora coccinea*	4-5	IV	4/5	13.2	33.8	22.75	40.74	33.94	3.207
5	*Gomphrena globosa*	3	II	3	74.73	6.03	25.73	26.43	76.81	0.372
6	*Tagetes patula*	3-4	III	4	81.27	4.05	31.59	31.85	82.7	0.312
7	*Nerium oleander*	4-5	IV	4/5	7.6	32.36	13.09	34.91	22.03	3.462
8	*Tagetes patula + Citrus reticulata*	3-4	II/III	3/4	72.69	9.14	29.64	31.02	72.86	0.436
9	*Citrus reticulata + Carica papaya*	4	II/III	3/4	72.1	-1.21	29.41	29.43	92.36	0.462
10	*Tagetes patula + Carica papaya*	3-4	III	4	77.36	6.51	31.71	32.37	78.4	0.366
11	*Spinacia oleracea L + Tagetes patula*	3-4	III	3	76.43	4.4	36.57	36.83	83.14	0.402
12	*Citrus limon + Carica papaya*	2-3	II-III	2/3	75.53	-1.18	25.73	25.76	92.63	0.398
13	*Luffa acutangula*	2	II	2	89.3	-1.93	14.05	14.18	97.8	0.159
14	*Solanum tuberosum*	2-3	II-III	2/3	61.56	14.59	61.64	63.34	76.69	0.819

Colour Parameters: The measure of the ability of a dye to impart color to materials is known as color strength. It is evaluated by light absorption in the visible region of the spectrum and the ratios of K/S values for samples as compared to a standard at the same wavelength, which expressed as a percentage. 'K' and 'S' are absorption and scattering coefficients of the dyed sample was called relative

color strength. The Kubelka-Munk equation 8, 9, 10 is calculated from reflectance, R and relative color strength (%) is followed as:

$$K/S = (1-R)^2 / 2R$$

CONCLUSION: The dyeing of cotton with the microbial pigments using *P. purpurogenum* was optimized and brown and yellow shades of colors are formed. There is a significant change occurs in K/S values but also in L* values and Munsell values. The three species *Hibiscus rosa sinensis*, *Ixora coccinea* and *Nerium oleander* exhibit highest K/S values. It is because of their ability for the formation of complexes with cotton. The interaction between the cotton and dye of these 3 flowers have high dye uptake. The microbially produced natural dyes are eco-friendly and useful for textile coloration process.

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