

Natural Dye Extraction from Ipomoea Indica Leave and Improvement of Fastness of Cotton Dyed Fabric under Gamma Radiation

Abdul Hafeez, Ayesha Hussain, Shahid Adeel, Dr. Muhammad Tahir Hussain, Unsa Noreen

Abstract— Nature offers us with prosperity of plants (Shrubberies, flowers and vegetables etc.) which produce color for the purpose of coloring. From the last few years, an increase importance has been industrialized to the probable use of raw materials from plants to produced natural dye for dyeing textiles due to environmental aspects. The present study deals with the extraction of natural dyes from Ipomoea Indica leaves to improve the strength of colour using 5kGy-20kGy doses of gamma radiation by following the process of mordanting. The result indicates that ipomoea indica plant leaves could be natural dye source for textile aspect. Copper sulphate (10%) and iron sulphate (10%) were the best pre mordants whereas as Copper sulphate (6%) and Iron sulphate (6%) were the best post mordants to improve the properties of colorfastness. The results attained from dyeing shows that gamma radiation of 10 kGy was the best dose for the modification of cotton fabric surface with the un-irradiated ipomoea indica leaves at 60 °C for 40 min dyeing time by using dye bath with the salt concentration of 10g/100ml produce better fastness properties.

Keywords— Colorfastness, Copper sulphate, Cotton, Iron Sulphate, Ipomoea Indica, Gamma Radiation , Natural Dye, Mordant.

1 INTRODUCTION

Color offers us attractiveness and gives us the opportunity for self-expression. The colors have remained common in different parts of world, particularly China, India, Central Asia and Egypt (Senha K et al., 2012). Human have been using natural assets like bark, stem, leaves, flowers and roots of plants to extract diverse colors for the fabric dyeing (Parkes 2002) Conventional understanding leads toward the conviction that natural dyes remain pleasanter to the atmosphere than their synthetic complements (Chengaiha et al., 2010).

Natural dyes not only have the property of colorant it also have the properties of medical. Nowadays there is increasing awareness amongst people towards natural dyes yielding and dye plants. Due to their fewer side effects, non-toxic properties, more medicinal values, natural dyes are used in our daily used food products and in medication industry (Singh et al., 2005).

Whereas Synthetic dyes are very harmful for human due to the use of many chemical's use for the manufacturing of dyes. The major problem are due to dioxin which is a carcinogen and possible hormone disrupter, toxic heavy metals such as chrome, copper, and zinc these are also known carcinogens and formaldehyde is also caused cancer.

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The dyed cloths are very harmful for skin and it causes the environmental pollution. That's why its need to use natural dyes as source of colorant for food and fabric (Aksu et al., 2007).

Radiations are being used in many processes such as metal coating, glass and plastics, printing and the finishing of wood and in the field of electrical insulation. Studies have indicated a hell of difference in the color strength un-irradiated and irradiated plant extract for the dyeing of un-irradiated and irradiated cotton fabric (Ahmad et al 2012).

Gamma radiation treatment to the cotton fabric gave different result in the form of tear and tensile strength and pilling. Gamma radiation at low dosages affect the physical properties of fiber, as dosages increased the affect become more apparent and significant on strength of yarn , fabric strength and abrasion resistance (Van der Sluijs et al 2013) (Batoool et al., 2013).

Ipomoea having almost 600-700 *Ipomoea* species belonging to Convolvulaceae is found throughout tropical and subtropical regions of the world. Many of these species have been used as food, ornamentals and medicines or in religious ritual (Mariod & Matthaus., 2008).

The study was a part of program to create the awareness against the use of synthetic product by introducing cheap and easily available natural colorant and Surface modification of fabric to improve natural colors under gamma radiation.

2 MATERIAL AND METHODS

Ipomoea indica leaves were collected from the surroundings of Faisalabad, Punjab, Pakistan. The leaves was washed in distilled water and then dried in the shade. Then dried leaves were ground finely and passed through sieve of twenty meshes for obtaining fine *Ipomoea indica* powder. The leaves powder was stored at room temperature before use. Plain weaved,

bleached and mercerized cotton fabric was purchased from Faisalabad textile market. The fabric was washed with soap following the methods as described by Li *et al.* (2007).

The *Ipomoea* leaves powder and fabrics were exposed to verified doses of gamma ray ranging from 5-20kGy using Cs 137 Gamma irradiator. The colorant extraction was carried out using irradiated and un-irradiated leaves powder (NRP). The extraction was done out by boiling the irradiated and non-irradiated powder of *Ipomoea Indica* leaves. The attributes related to spectra flash spectrometer (SF-650) and fastness tester was recorded (Gorensek *et al.* 2012) at Noor Fatima Textile Private Limited Faisalabad, Punjab Pakistan. The physical testing facilities were provided by National Textile University, Faisalabad, Pakistan.

Extraction of dye from non-radiated powder (NRP) and gamma irradiated dye powder (RP) of *ipomoea indica* using water, methanol and alkali as an extraction media. Non-irradiated powder (NRP) and (RP) was mixed with distilled water, methanol and alkali using (M:L 1:30) in a 500ml beaker and stirred for 45 min on hot plate. The extract was filtered using cotton cloth of fine pores and stored for further experiments.

The above mentioned extraction process was used for irradiated dyed powders of *Ipomoea indica* leaves exposed to gamma radiations for 30, 40, 50 and 60 minutes. The optimal condition were used for colorant from *Ipomoea* leaves treated with extraction at variable doses of gamma radiations, such as (RP) 5, 10, 15 and 20kGy for 30 minutes. The varied salt (NaCl) concentrations were ranging from 2-10g/100ml of extraction media, M: L ratio (1:20, 1:30, 1:40, 1:50 and 1:60), dyeing time ranging from 20-60 minutes and dyeing temperature 30, 40, 50, 60 and 70 °C were also optimized. After the extraction, fabric was dyed, dried and evaluated for color strength and fastness characteristics.

The pre and post-mordanting of dyed fabric was carried out with 2-10% at each of copper and iron solution. After pre-mordanting the fabric was washed with water and then dyed with *Ipomoea indica* extract at optimal conditions. The pre and post mordanted dyed fabric was subjected to laboratory analysis from determination of color values (Naz *et al.* 2011). Fastness properties of colorant extracted from *Ipomoea* leaves were evaluated using standard methods, such as washing fastness by ISO 105-CO3 process and rubbing fastness according to ISO 105 X-12 methods. Fastness to light were evaluated by utilizing light fastness meter according to ISO 105-B02 method. Grading was noted using ISO grey scale for the change in color reading.

3 RESULTS AND DISCUSSIONS

Ipomoea indica leaf powder exposed to various doses of gamma radiation and gave different color strength. It was evaluated that extraction with alkaline media gave better color

strength as compared to aqueous and methanol extract (figure1, figure 2 and figure 3). The results show that NRP with RC of 10kGy with alkaline extract gave better color strength result.

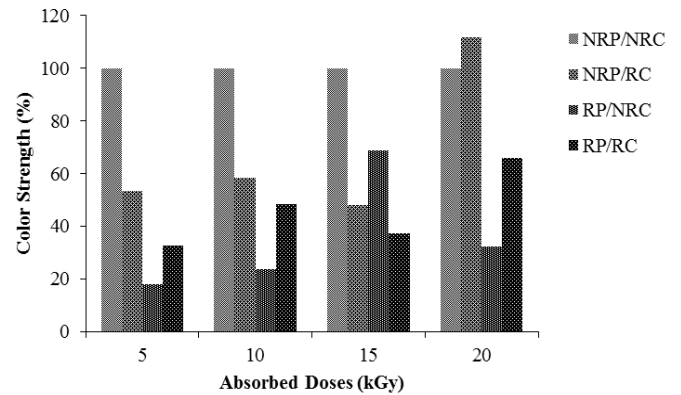


Fig. 1. Influence of Aqueous as an Extraction media on dyeing of cotton fabric with *Ipomoea Indica* leaves.

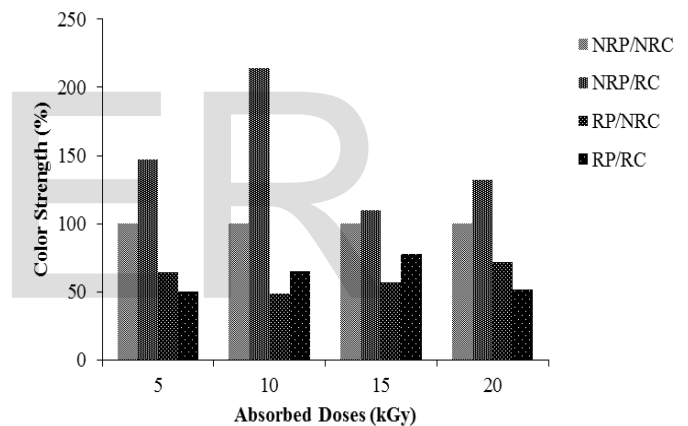


Fig. 2. Influence of Alkali as an Extraction media on dyeing of cotton fabric with *Ipomoea Indica* leaves.

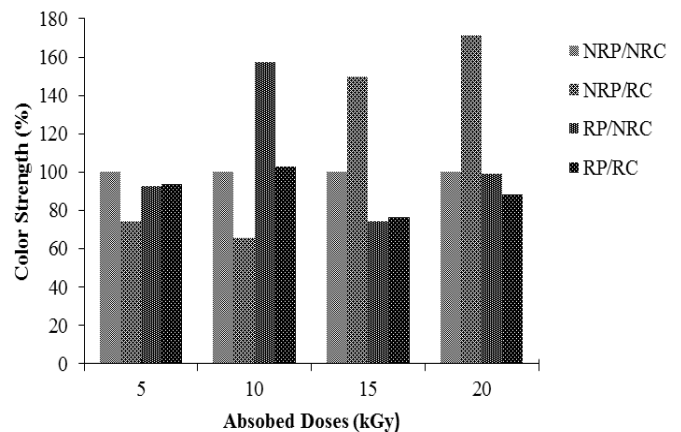


Fig. 3. Influence of Methanol as an Extraction media on dyeing of cotton fabric with *Ipomoea Indica* leaves.

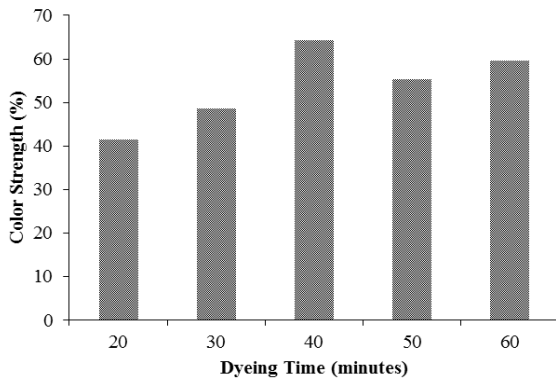


Fig. 4. Influence of dyeing time on cotton fabric with ipomoea indica extract.

When a cotton yarn, dyed with a direct dye is treated with hot water, especially in the presence of soap, the weak bonds formed between the dye molecule and cellulose macromolecules break the dye comes out from the fiber and dissolves in the water (Cristea & Vilarem., 2006).

When cellulosic fiber is dyed with a direct dye for a sufficiently long time, the dye enters the fiber structure and is generally distributed in the interior of the fibers, while it remains mainly on the surface with slight diffusion, when dyed for a short time.

The results shown in figure 4 shows that NRP with 10kGy RC gave better results at 40minutes of dyeing time. It is seen that with increasing time, the dye uptake, increases rapidly in the initial stages of dyeing but later on it varying.

It is found that when direct dyes are dyed on cellulosic fibers, the amount of the dye taken up is considerably less than when a salt such as sodium chloride is present in the dye bath. When a cellulosic fiber is immersed in water, it acquires negative electrical charges. As a result the negatively charged fibers surface repels the negative charged dye ions when present in the solution. When salts are added to the dye bath, they try to neutralize or reduce the negative charge of the fiber, thereby facilitating the approach of the formation to within the range of hydrogen bond formation or of the formation of other bonds between the dye and the fiber.

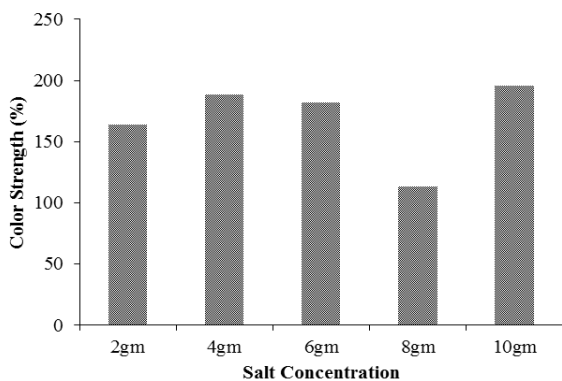


Fig. 5. Influence of salt concentration on dyeing of cotton with ipomoea indica dyestuff

The figure 5 show that as salt concentration increases to 4g then the color fastness increases as salt concentration increases from 4g to 8g then the color fastness decrease and increases rapidly at concentration 10g of salt.

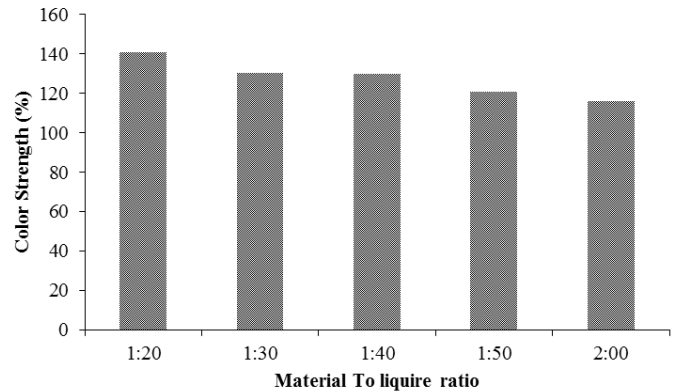


Fig. 6. Influence of Material to liquore ratio on dyeing of cotton fabric by using the extract of Ipomoea Indica leaves

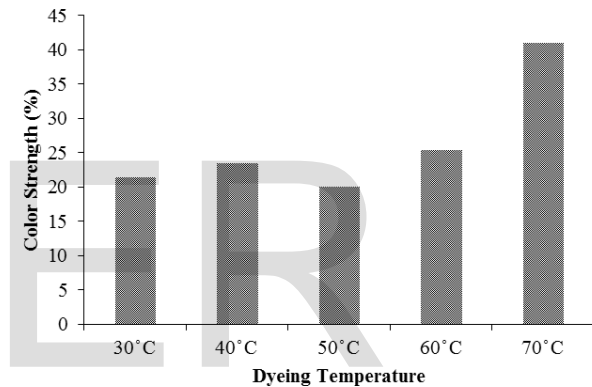


Fig. 6. Influence of Dyeing temprature on dyeing of cotton fabric by using the extract of Ipomoea Indica leaves

Pre-mordanting impact

The result given in figure 4.5 for pre-mordanting show that 10% of Fe gives better color strength as compared to Cu. This is due to low radiation power of Iron as well as good complex formation ability with dye onto surface modified fabric.

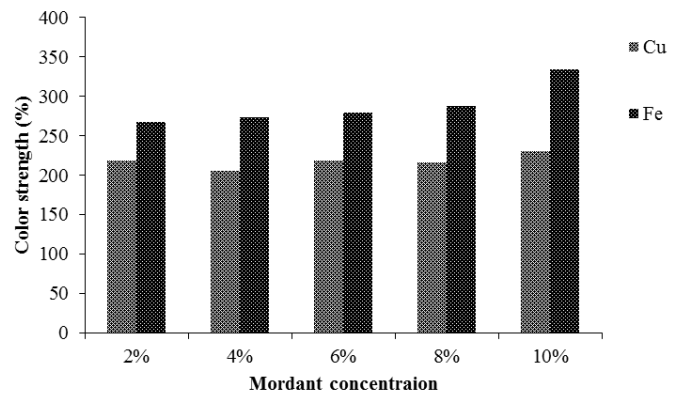


Fig: 7. Influence of Pre-mordanting on dyeing of cotton fabric by using the extract of ipomoea Indica leaves

Condition	Iron (Fe)			
	Color strength %age	dL*	da*	db*
2%	268.08	-7.94	3.97	7.99
4%	273.08	-10.19	3.53	6.04
6%	279.77	-10.41	3.38	6.29
8%	287.44	-9.93	4.10	7.67
10%	334.37	-10.31	3.71	9.67

Table 1. Influence of Pre-mordanting of Iron on dyeing of cotton fabric with Ipomoea Indica leaves

Concentration	Copper			
	Color strength %age	dL*	da*	db*
2%	218.42	218.42	218.42	218.42
4%	206.13	206.13	206.13	206.13
6%	218.95	218.95	218.95	218.95
8%	216.71	216.71	216.71	216.71
10%	231.22	231.22	231.22	231.22

Table 2. Influence of Pre-mordanting of Copper on dyeing of cotton fabric with Ipomoea Indica leaves

Post-mordanting impact

The fig. 8 for post mordanting shows that 6 of Fe give good color strength. But overall as compared to pre-mordanting, post mordanting did not give significant color depth. This might be due to even dyeing on fabric which upon mordanting show shades variability. Cu also did not give significant results due to less stability of complex onto fabric which upon washing were removed off.

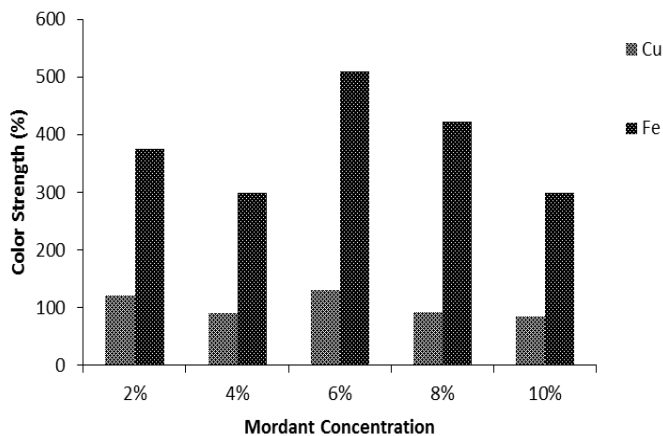


Fig. 8. Influence of Post-mordanting on dyeing of cotton fabric by using the extract of Ipomoea Indica leaves

Conditions	Iron (Fe)			
	Color strength %age	dL*	da*	db*
2%	375.79	-11.73	4.70	10.79
4%	298.44	-6.42	5.94	13.70
6%	508.69	-12.46	6.57	15.89
8%	421.72	-11.57	5.99	13.51
10%	298.91	-10.64	3.86	7.71

Table 3. Influence of Post-mordanting of Iron on dyeing of cotton fabric with Ipomoea Indica leaves

Concentration	Copper			
	Color strength %age	dL*	da*	db*
2%	121.06	-4.32	-5.19	-2.61
4%	90.64	-0.96	-0.63	-3.46
6%	129.88	-4.46	-4.22	-1.70
8%	92.16	-0.87	-5.55	-3.01
10%	84.76	-0.36	-6.21	-3.78

Table 4. Influence of Post-mordanting of Copper on dyeing of cotton fabric with Ipomoea Indica leaves

4 CONCLUSION

Now, luckily, there is exploding knowing among group towards unprocessed products. Due to their non-toxic properties, low dirtying and little cut effects, natural dyes are used in day-to-day food products.

The results obtained from the current studies expressed that Gamma-irradiation on material artifact gave change coloration capableness and timber fixedness properties of dyed fabric. The results are also evaluated that there is no meaning of Gamma-irradiation of powder of Ipomoea leaves as process of dyeing then the fixity properties decreases and un-irradiated radiation of ipomoea indica gave improve finish with irradiated cloth.

Good color strength obtained by NRP and RC fabric dyeing with the alkaline extract at 70 °C for 40min using salt concentration of 10g/L.

Copper 10% and iron 10% are the best pre-mordanting agents and 6% copper and 6% iron are the best post mordanting agents and improve the color fastness properties and color strength of un-irradiated ipomoea indica leave powder cotton dyed fabric.

Gamma radiation especially 10kGy dose are very helpful to improve the surface modification and color fastness.

5 Acknowledgments

The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments. Avoid expressions such as "One of us (S.B.A.) would like to thank" Instead, write "F. A. Author thanks" Sponsor and financial support acknowledgments are included in the acknowledgment section. For example: This work was supported in part by the US Department of Commerce under Grant BS123456 (sponsor and financial support acknowledgment goes here). Researchers that contributed information or assistance to the article should also be acknowledged in this section.

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