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Natural dyes with future aspects in dyeing of Textiles: A research article

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Abstract: Dyeing is a complex, specialized science. Nearly all dye stuffs are now producing from synthetic compounds. This means that costs have been greatly reduced and certain application and wear characteristics have been greatly enhanced. But many practitioners of the craft of natural dyeing (i.e. using naturally occurring sources of dye) maintain that natural dyes have a far superior aesthetic quality which is much more pleasing to the eye. On the other hand, many commercial practitioners feel the natural dyes are non-viable on grounds of both quality and economics. In the west, natural dyeing is now practiced only as a handcraft, synthetic dye being used in all commercial applications. Some craft, weavers and knitters use natural dye as a particular feature of their work.
Key Words: Natural Dye, Economics.

Introduction:

Textile processing industry is one of the major environmental polluters as the effluent from these industries contains a heavy load of chemicals including dyes used during textile processing. There are two main ways to limit the environmental impact of textile processing. One is to construct sufficiently large and highly effective effluent treatment plants, and the other way is to make use of dyes and chemicals that are environment friendly [(1)]. The rich biodiversity of our country has provided us plenty of raw materials, yet sustainable linkage must be developed between cultivation, collection and their use[(2)]. Natural dyes can produce special aesthetic qualities, which, combined with the ethical significance of a product that is environmentally friendly, gives added value to textile production as craftwork and as an industry.

Natural dyes can offer not only a rich and varied source of dyestuff but also the responsibility of an income though sustainable harvest and sale of these dye plants[(3)]. Many dyes are available from tree waste or can be easily grown in market gardens. In areas where synthetic dyes, mordents (fixatives) and other additives are imported and therefore relatively expensive, natural dyes can offer an attractive alternative. Recently there has been a revival of the growing interest on the application of natural dyes on natural fibres due to world-wide environmental consciousness[(4)]. They also reported that recently a number of commercial dyers and small textile export houses have started looking at the possibilities of using natural dyes for regular basis dyeing and printing of textile to overcome environmental pollution associated with synthetic dyes.

For successful commercial use of natural dyes, the appropriate and standardized dyeing techniques need to be adopted without scarifying required quality of dyed textiles materials. Therefore, to obtain newer shades with acceptable colour fastness behavior and reproducible colour yield, appropriate scientific techniques or procedures need to be derived from scientific studies on dyeing methods, dyeing process variables, dyeing kinetics and compatibility of selective natural dyes. A need has also been felt to reinvestigate and rebuild the traditional processes of natural dyeing to control each treatment and predyeing process (preparation,

mordanting) and dyeing process variables for producing uncommon shades with balanced colour fastness and eco-performing textiles.

Materials and methods:

Source: *Punica granatum* (pomegranate) and *Targetes erecta* Linn (Marigold flowers). The dyeing of cotton/synthetic fabric was carried out in three stages; Extraction of dye from the plant source, mordanting and dyeing.

Extraction of dye:

Various experiments were conducted for the maximum extraction of natural dye from the pomegranate peels, marigold flowers. The samples were collected and washed thoroughly with water to remove any dirt. After thorough dyeing at room temperature, the samples were ground into powder using grinder. To find the optimum extraction condition, experiment were conducted in aqueous extraction at various range of pH (3-8) and temperature (30± 2 and 100 **°C**) with M:L ratio 1:10.

Mordanting

Two chemical mordant's namely ferrous sulphate and copper sulphate, alum and harda (tannin treatment) were used as a natural mordant. Mordanting was carried out in three stages: Pre-mordanting, Simultaneous mordanting and Post-mordanting

Pre-mordanting

In pre-mordanting the scored fabrics were first treated with mordant and then dyed using extracts for each plant separately. The fabrics were treated with each of the mordant mentioned above at the 1:10 M : L ratio for 40 minutes at 30 ± 2^0C. Then the mordanted fabric was used for dyeing.

Simultaneous mordanting

In this method the fabrics were immersed in equal mixture of the mordant and the dye extract for 40 min at 28 ^{0}C followed by washing and drying of the dyed fabrics.

Post-mordanting

In case of post-mordanting, the dyed fabric was treated with mordants at 30±2^0C for 50 min with M:L ratio 1:10.

Dyeing

Experiments were performed in each dyeing was done at 30±2^0C and for 30 min.

Washing Fastness

Dyed sample was placed between two pieces of non dyed white samples (control). These three pieces were held together by stitching round the edges. The pre-heated soap solution (Tide at 55°C) in the ratio of 1:50 i.e 0.5g/25 mL water, was taken in a vessel added 1.0 g of sandwiched fabric for 45 minutes Then the specimen was removed and rinsed in cold water[(4)].

Rubbing fastness

The rub fastnesses of the dyed fabrics were carried out by rubbing the fabrics manually and checking for fading of color by using **Crock meter [(5,6,7)].**

Light Fastness

The fabric was exposed to sun light for 24 h. The colour fastness to light was evaluated by comparison of colour change of the exposed portion to the unexposed original material [(4)].

Results and discussion

Punica granatum is from the family Punicacea. It grows in all warm countries of the world and was originally a native of Persia. The rind of pomegranate contains a considerable amount of tannin, about 19% with pelletierine The main coloring agent in the pomegranate peel is granatonine which is present in the alkaloid form N-methyl granatonine[8].

Marigold (*Tagetus erecta***)** belongs to the family Asteraceae. The principle colouring component of marigold flower is lutein, a fat-soluble carotenoid**,** which is responsible for the yellow to orange colour of the dye[9].

(i) **(ii)**

Fig (1) (i) *Punica granatum* (pomegranate) (ii) *Targetes erecta* Linn. (Marigold flowers)

Extraction of dye

The yield of the dye per 100 g of the plant specimen obtained under various extraction conditions are summarized in the Table 1.Yield of the dye can be improved by using techniques like rotary evaporator for concentration of the dye. Extraction of dye from Marigold flower employing aqueous/organic solvent extraction method for 5 h/ 2.5 h resulted in 3.5 and 4.6 g per 100 g of the dry flower respectively[11]. From Table 1, it was observed that the extraction of dye was a function of pH.

Table-1 Dye obtained from Marigold and Pomegranate peel under various extraction conditions.

Dye	Extraction medium	Temp (±2)^0 C	Time	pH [yield of dye(mg/100 gm of specimen)]			
				3	5	7	8
Marigold	Aqueous	30^0 C	24 h	100	250	400	20
		100^0 C	50 min	80	100	150	120
Pomegranate peel		30^0 C	24 h	100	200	300	550
		100^0 C	50 min	60	80	90	80

Mordanting and Dyeing

Mordants play very important role in imparting color to the fabric. The mordants used in combination in different ratios gave varying shades. Better colour strength results are dependent on the metal salt used. Strong co-ordination tendency of Fe enhances the interaction between the fiber and the dye, resulting in high dye uptake (3). Ferrous sulphate and Copper sulphate and alum have the ability of forming coordination complexes.

Functional groups such as amino and carboxylic acid on the fiber can occupy the unoccupied sites on interaction with the fiber. Thus, a ternary complex is formed by the metal salt on which one site is with the fiber and the other site is with the dye. The mordanted cotton cloth was immediately used for dyeing because some mordants are light sensitive (3,10). The chromatophore of the dye makes it resistant to photochemical attack, but the auxochrome may alter the fastness. The resistance of a dye or pigment to chemical or photochemical attack is an inherent property of the dye chromophore. The results of the present experiments on dying with Marigold and Pomegranate peel are shown in the Figures 2 and 3 respectively.

Name of the mordants	Type of mordanting					
	Pre		Simultaneous		Post	
	Cotton	synthetic	Cotton	synthetic	Cotton	synthetic
Harda						
CuSO4						
FeSO4						

Figure 2. Dying with Marigold flower Extract

Name of the mordants	Type of mordanting					
	Pre		Simultaneous		Post	
	Cotton	synthetic	Cotton	synthetic	Cotton	synthetic
Harda						
CuSO4						
FeSO4						

Figure 3. Dying with Pomegranate peel Extract

Conclusion:

The present scenario is focused more towards the utilization of the vast diversity of natural resources of colour pigments for their use in food materials, pharmaceuticals and textiles, in place of their synthetic counterparts. This trend is aimed at safeguarding human health as well as protecting and prolonging life on earth. Therefore, if natural dyes have to be commercialized, they need to conform to the same stringent standards of performance that are applied to synthetic dyes. It thus follows that much more research and developmental effort needs to go in this area.

References

1. Ali S. Hussain T and Nawaz R, Optimization of alkaline extraction of natural dye from Henna leaves and its dyeing on cotton by exhaust method, J Cleaner Production, 2009, 17 (1), 61-66.
2. Kumaresan M, Palanisamy PN and Kumar PE, Application of Eco-Friendly Natural Dye Obtained from Flower of Spathodea Campanulata on Silk Using Combination of Mordants, European J. Sc Research., 2011, 52 (3), 306-312.
3. Jothi D, Extraction of natural dyes from African marigold flower Tagetes erecta for textile coloration, Autex Research journal, 2008, 8 (2), 49-53.
4. Samanta AK, and Agarwal, Application of Natural Dyes on Textiles, IJFTR, 2009, 34, 384-399.
5. Adeel S, Ali S, Bhatti IA and Zsila F, Dyeing of cotton fabric using Pomegranate (Punica Granatum) aqueous extract. Asian J. Chem. 2009, 21(5), 3493-3499.
6. Raja D, Arputharaj A, Prakash C, Ramesh B and Koushik CV, Study on Dyeing Behaviour of Cotton/Organic Cotton Knitted Fabrics. Indian J. Sci Technol, 2010, 3(7), 746-751.

7. Mishra P and Patni V, Extraction and Application of Dye Extracted from Eriophyid Leaf Galls of Quercus Leucotrichophora -A Himalayan Bluejack Oak, African J. Biochem Research, 2011, 5(3), 90-94.
8. Goodarzian, H and Ekrami E, Wool Dyeing with Extracted Dye from Pomegranate (Punica Granatum) Peel, World Appl. Sc. Journal, 2010, 8 (11), 1387-1389.
9. Chengaiah B, Mallikarjuna Rao K, Mahesh Kumar K, Alagusundaram M, Madhusudhana Chetty C, Medicinal importance of natural dyes a review. Int. J. Pharmtech Research. 2010, 2 (1), 144-154.
10. Kulkarni SS, Gokhale AV, Bodake UM and Pathade GR, Cotton Dyeing with Natural Dye Extracted from Pomegranate (Punica granatum) Peel, Universal J Environ Research Technol, 2011, 1(2), 135-139.
11. Padma Vasudevan, Suman Kashyap and Satyawati Sharma, Tagetes: A Multipurpose Plant, Bioresource Technology, 1997, 62, 29- 35.
12. Kamel MM, Helmy HM and Hawary NS, Some Studies on dyeing properties of Cotton fabrics with Crocus Sativus (Saffron) flowers using an ultrasonic method. Autex Research Journal, 2009, 9(1), 29-35.

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