

Innovative Natural dyeing Technology

Process developed for Natural dyeing

Innovative Method for Extraction of dyes: Efficient extraction of the dye from the plant material is very important for standardization and optimization of vegetable dyes.
Utilizing

- a) Soxhlet
- b) Conventional Boiling
- c) Sonicator methods

Innovations

- Improved extraction procedure
- Less use of Metal Mordants
- Introduction of use of Enzymes in dyeing
- Use of Bio-mordants
- Innovative Method for dyeing
- Optimization of the dyeing procedures

Quality Standards for Natural dyes

- Quality standards for natural dyes vary widely, so it is necessary to first contact an importer to find out what they are looking for. The problem arises with standardization of the colors as no two dye lots are identical, technicians in the pharmacology, food and textile industry loathe this lack of consistency.
- For attempting repeatability of shades for textile dyeing the recommended procedure as mentioned in the earlier chapters should be followed strictly and it should be always practiced that :
- Use only S.S. Dye-bath
- Water hardness should not be more than 300 ppm.
- Yarn water ratio should be 1:20

Cotton Natural Dyeing on the existing Jigger machine



Silk Dyeing on Winch machine no new set up required



Economics of Natural Dyeing for Cotton fabric

Dyeing of 1 square meter cotton fabric by natural dyes ranges from Rs 6.00-15.00, where as synthetic dyes costs Rs 4.00-9.00. For a mere rate enhancement of Rs 2.00-6.00, the value addition obtained by vegetable dyeing is far more in terms of ecological and aesthetic values.

Natural dyeing of Cotton shirt

Dyeing a cotton shirt which requires 2.5 meters of cloth the cost of dyeing is raised by Rs 5.00-10.00 , which can be sold for Rs 150 in place of Rs 75 due to its value addition attributes.

Natural Dyeing of Silk saree

Dyeing a silk saree requires 5.5 meters of material to be dyed, the cost of dyeing is enhanced by Rs 10-20, and the saree can be sold for triple its original cost ie Rs 1500 for a saree worth Rs 500.

Cost analysis of cotton dyeing with anar ka chilka

Cost analysis for a representative dye:

Punica granatum(Anar ka Chilka)

Cost per Kg—Rs 315/

Tax @11 % --- Rs 35/

Total cost per Kg—Rs 350/-

Utilization of dye 5 % at this rate would be Rs 17.50/-

Additional cost of Chemicals---	Rs2.50/-
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Processing charges ---	Rs 15/-
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Total	Rs 35.00/-
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For a cloth of GSM 100

1 Kg material -----10 sq meters so cost of dyeing 1 sq meter—Rs 3.50

For a silk saree of 6 meters

An undyed silk saree (6 meters) cost Rs 900.00

- Cost of dyeing is Rs 21.00
- Total cost Rs 921.00
- Market selling price of Naturally dyed saree Rs 1650.00
- Total value addition 79.15 %

Documentation of the work

- Book- Process Development of Vegetable dyeing prepared By Dr Padma S Vankar, FEAT Lab, IIT Kanpur and submitted to KVIC , Mumbai
- Film- Video Film on Process Development of Vegetable dyeing shot during the Demonstration held in Swarajya Ashram, Kanpur prepared By Dr Padma S Vankar, FEAT Lab, IIT Kanpur and submitted to KVIC , Mumbai

Specific dyeing for Cotton, Silk & Wool

- Silk dyeing with different newer mixtures of natural dye sources specially developing for Khadi garment industry for different hue color development
- Cotton dyeing with the same new combination natural dyes for Cotton/Kota and Chicken embroidery work

Usage of Newer Natural dyes

- Newer Dyes developed were used for dyeing silk and cotton
- Different pretreatments and mordant for better fastness properties of the fabrics-wool, silk and cotton.
- Development of innovative dyeing of wool for commercial use in carpet industry
- Preparation of 16 dyed fabric for development of different colors

Need for Betterment

Tedious Extraction Process

Low color value and long dyeing time

Higher cost of dyeing.

Use of Metal Mordants

Frequently used metal salts are of Fe, Al, Cu, Pb and Sn.

Using these metal mordants have ecological constraints as they generate polluted effluent from dye bath.

Why there was a need for better process

Traditional Dyeing Process

Enormous amount of heat is consumed in terms of heating the dye bath to obtain desired color. Heat sensitive dyes cannot be used in conventional dyeing. Prolonged heating decomposes the dye molecules.

Dye uptake by the fabric is also far from exhaustion; as a result fair amount of dye is wasted in traditional methods.

For successful use of natural dyes , we need to do the following

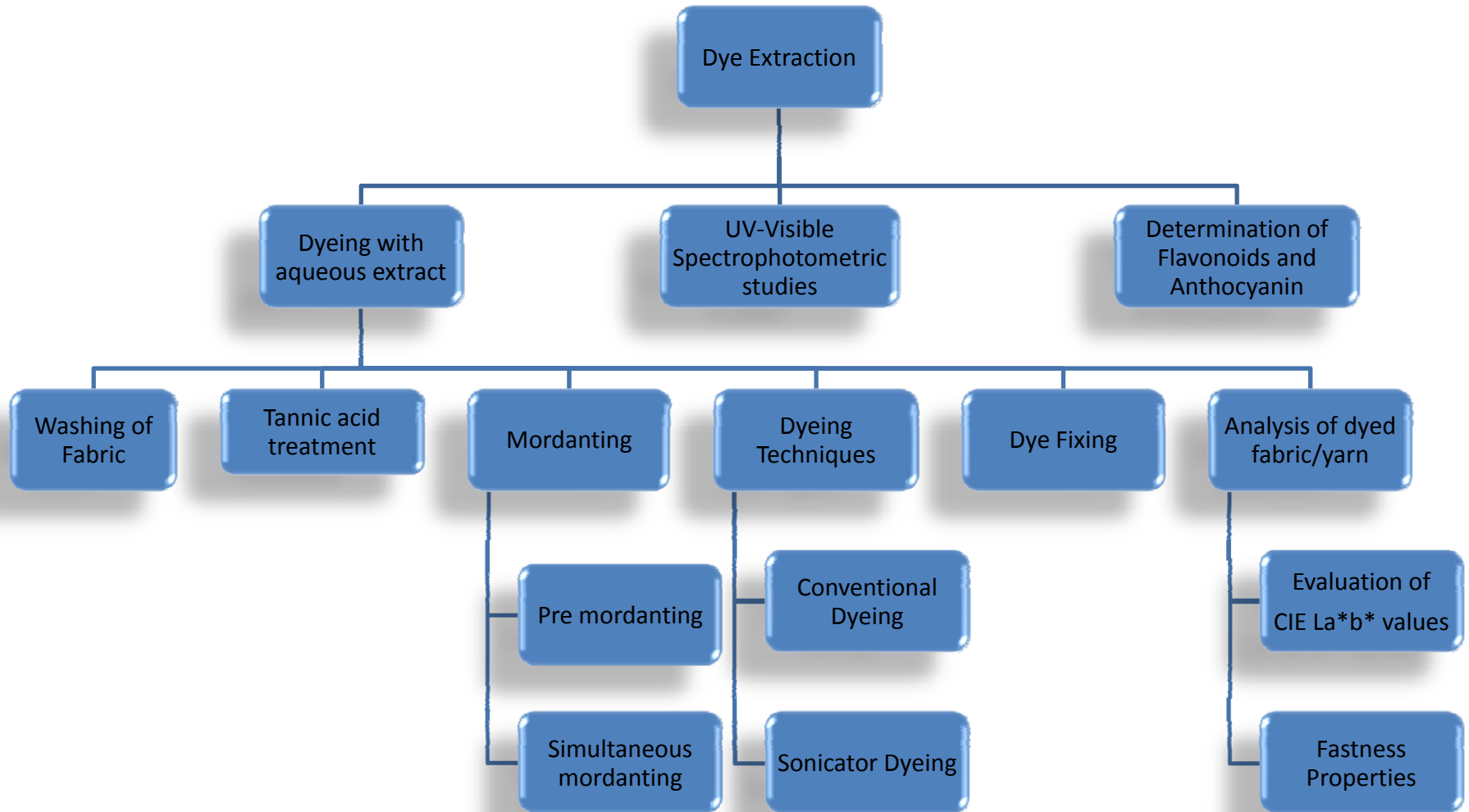
Reinvestigate and rebuild the traditional dyeing processes.

Adopt appropriate and standardized dyeing techniques which should be based on scientific studies like dyeing methods, dyeing process variables, dyeing kinetics and compatibility of selective natural dyes.

Novelties of our work

- Use of newer source of Natural Dyes to get new hues and shades in fabric. Used four plants namely – *Hibiscus mutabilis*, *Eclipta alba*, *Rubia cordifolia* and *Cayratia carnosa* for dye extraction. ***Hibiscus mutabilis* and *Cayratia carnosa* were attempted for the first time.**
- **Use of bio-mordants** obtained from plant materials and selected enzymes in place of metal mordants to prevent the toxic effect of metal ions. Enzymes used were - Cellulase, Protease & Trypsin and plant material (***Eurya acuminata* and *Pyrus pashia***) as bio-mordants for dyeing cotton, wool and silk.
- Introduction of a newer technique for dyeing i.e. **Ultrasonication** which has given encouraging result with respect to dye uptake capacity as compared to conventional dyeing method.
- To make the whole dyeing process **bio sustainable and more eco-friendly.**
- The overall idea was to develop a cheaper and greener process using enzymes and bio-mordants in dyeing with natural resources and optimization of different parameters for this kind of study to increase brightness and color depth on every kind of fabric.

General Strategy for Natural dyeing work



Why research is needed

- India has long tradition of natural dyeing and also possess raw material for extraction. There is plenty of scope for rapid development in the area of agricultural production, processing and dyeing of natural dye plants. As we have a lot of sources and wide ranges of plants, India has good scope for export of naturally dyed goods to developed countries.
- Exploring new places for natural dye yielding plants like Arunanchal Pradesh, Madhya Pradesh.
- There is plenty of scope for rapid development in processing and dyeing of natural dye plants. In this way a number of rural people can make progress. Thereby providing economic and ecological benefits.
- There is an urgent need to promote the use of eco-friendly natural dyes for coloration of textile and to improve their aesthetic quality.
- **mechanism of dyeing.**

Scientific interventions

- Scientific methods of extraction and behavior are yet to be established for majority of this kind of natural dyes as well as purification of the colorant, color fastness, hue color with different mordents, different treatments like enzyme treatment, biomordanting and color stability are some of the factors which are also not studied in detail.
- Demand of natural colors has been greatly increased in textiles, cosmetics, leather, food and pharmaceutical industries, it is high time to switch over to natural colors. **There is a great need to elucidate chemical structures of colorants present in these newer sources of natural dyes, thereby studying the effect of mordant and**