The role and development of vegetable dyes in Indian handlooms

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India has a hoary tradition in the arts of handloom weaving and vegetable dyeing. The knowledge of sourcing of the plant materials, from which the dyes are obtained, is being passed on so far purely by way of tradition, from generation to generation. So, also is the art of extraction of the dyes and their application to the yarn/cloth. Vegetable dyeing is very eco-friendly and has several unique characteristics. The paper pleads for the preservation of this ancient art and for a greater thrust on R & D in all the relevant fields of raw material, extraction, application and production of the vegetable dyes.

Keywords: Natural dyes, Vegetable dyes, Indian handlooms, Mordant, Indigo dye

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Human beings, in their evolutionary process, started to use clothes to cover their bodies. Gradually, not satisfied with plain clothes, they started using clothes in attractive colours and shades. Thus, the art of dyeing cloth came up. It is believed to have been known in China, India and Egypt more than even 4,000 yrs ago. In India, there are paintings in Ajantha and Bagh caves and references in Bhrigu Samhitha and Firdausi’s Shah Nama, indicating the use of natural dyes, hundreds of years ago. Indigo is one of the oldest natural dyes known in India. In fact, the art of Calico printing is stated to have had its origin in India. The role of Indigo and the rise of Indigo planters of Champaran in Bihar in the recent past and the travails that they underwent when its cultivation was stopped are well known. Even as, on one side, the art of using natural dyes was being widely practiced, on the other, the art of handloom weaving was thriving in various parts of the country. In different places of the country, from North to South and East to West, such as Paithan, Patola, Pochampalli, Gadwal, Kota, Maheshwari, Chanderi, Tangail, Dhuniakali, Cuttack, Sanganer (Baandini), Venkatagiri, Madurai, (Sungudis) Dharmavaram, Kanchi, Arni or Salem, unique designs of handloom saris were woven. The two trades of handloom weaving and vegetable dyeing were inextricably intertwined. This mutual complimentarily has been one of our greatest strengths. Natural dye enhances the appeal of the hand-woven cloth manifold; nay, without dyeing, the variations of the designs in the woven cloth may not be apparent and their uniqueness may be totally lost (Figs. 1, 2).

Just as the Lancashire mills made deep inroads into the Textile sector in India, William Henry Perkins synthesized the Mauve colour dye in 1856. This was followed by the synthesis of Magenta by a French chemist and Alizarin in 1869 by British & German Scientists. Synthetic Indigo was produced in 1880, based on the research work of von Bayer. Aniline was produced from coal tar, giving rise to Aniline dyes and synthetic vat dyes started replacing natural dyes. Thus, though from the remote past till the last century, India's superiority in natural dyes and in developing excellent colour designs and fastness of shades was undisputed, the advent of synthetic dyes, their easy availability, comparative ease of application and the simultaneous availability of mill made yarn and cloth, made the artisans change from vegetable to synthetic dyes and from handloom to mill cloth. Like many other traditional sectors, the art of vegetable dying also slowly faded out, flickering only in isolated pockets. However, of late, it is a happy augury that, with increasing consciousness to protect our environment and traditions, the wheel has come full circle and the natural dyes are slowly coming into their own in our country.
Methodology

The paper focuses its attention on the entire gamut of dyeing of yarn/cloth with natural dyes, mainly vegetable dyes, (the others in the group of natural dyes being lichen and mineral dyes) starting from the stage of raw materials required, the process of their extraction, application on yarn/cloth, uniqueness, marketing and the need to preserve the art. It seeks a proper place for this art in the Indian textile sector and also makes some recommendations, mainly pleading for a greater thrust on R&D.

Vegetable dyes

Vegetable dyes are organic in nature. They are derived from various parts of plants, as against synthetic dyes, which are obtained through chemical reactions in factories. Vegetable dyes so extracted from natural sources, are organic compounds with complex structures, containing colouring matters in a single dye. The colouring principle in Indigo is blue indigotin. But natural indigo leaves also contain small amounts of indirubins of reddish and yellow colours, thus giving colours unmatched by the synthetic indigo. Some other popular examples of dye yielding plants apart from Indigo are, madder or Manjishta, whose roots yield a rich red dye; safflower; the seeds of the fruit of Annato tree yield a bright orange colour; turmeric giving a bright yellow colour; rind of the pomegranate fruit; Parijatha flower, etc. (Fig. 3). While most of these raw materials are widely dispersed and available in most parts of the country, there are some plants, which are only available in limited pockets in some remote parts of the country; e.g. saffron in Kashmir or Osak and Khum in Manipur, Assam and parts of Northeast India. Quite a few of these raw materials are also common to the Ayurveda and Siddha medical systems (Figs. 4-8).

Until recently, there has been no clear cut record of the plants, which yield the dyestuffs and each artisan had been following the practice of what his forefathers had been using in that part of the country. Such an identification of the numerous dye yielding plants in various parts of the country, is a painstaking process. Only recently, some small attempts have been made in this regard. Some researchers have presented list of 138 dye bearing plants, with their botanical names, the part of the plant that has to be used and the colour that will be obtained from it. While others have compiled a list of 465 plants with their botanical and vernacular names, 30 lichens, 8 animal and 6 mineral sources of dyes, found throughout India. These lists give an idea of the enormous amount of survey yet to be done, to systematically identify the numerous vegetable dye yielding sources spread all over the country. In comparison to the Japanese methods of Indigo cultivation, our methods seem to be primitive as the yields are comparatively low and of poor quality. In the interests of promoting vegetable dyes in India, the tasks of survey and increasing of yields has to be taken up in all seriousness, at the earliest.

Vegetable dye extraction and application

Both the process of extraction and application of the dye on the yarn/cloth are, very laborious and time consuming. First, the requisite quantity of the specific part of the plant, which is the dye material, has to be collected. Then it is ground to powder and dissolved mostly in water or any other suitable liquid, in a container, for treatment with the yarn /cloth for dyeing. In traditional methods, in the small scale, both the plant and the material to be dyed are boiled together. Most vegetable dyes are extracted by pulverizing, grinding or soaking the herbs. Some plant material like Indigo leaves, however, needs to be fermented, to release the glucosides of the dye. The Indigo plant is therefore, steeped in specially constructed water tanks, called vats, churned, left to settle, the sediment collected and dried in the sun, to get the Indigo cake. There are two ways of application of natural dye directly on cloth instead of yarn, Kalamkari and Block printing. Both of these traditional Indian crafts, which were in oblivion, are slowly coming to enjoy a period of renaissance. These are specialized arts by themselves.

Use of mordants

Animal fibres like wool & silk, take up vegetable dyes easily, but cotton is very resistant, because of presence of waxes and resin in it. Soft absorbent textiles like handspun and hand-woven Khadi have proved invaluable for use with vegetable dyes. Soft cotton in its original state, with minimum processing, is the ideal material for vegetable dyes. In the case of quite a few natural dyes, chemical in the form of metal salt, tannin or oil is needed to create an affinity between the fibre and the pigment. This is known as a mordant. Some of the common mordants are, chemical salts such as alum, potassium dichromate, ferrous sulphate and copper sulphate or tannins like...
myrobalan and sumach or oils like Turkey red oil. Mordants can be applied before the dye, after the dye, both together, etc. In the case of cotton, in order to make the yarn absorbent and obtain level dyeing, good penetration of the dye and fast shade, impurities in the yarn have to be removed by boiling the yarn in an alkaline solution. However, mordants cause extreme pollution and should be used only within manageable limits.

**Current status of vegetable dyes research**

There are two aspects in this regard: Firstly, R & D in the field of extraction and application and subsequent standardization of the dye on the cloth; secondly commercialization of the production of the dye in the form of a cake or powder. The initial stirrings of R&D could be traced to the first Vegetable Dye Research Laboratory in the country set up 50 yrs ago at Kalakshetra, Adyar, in Chennai. This laboratory took up the first aspect referred to above. After a decade, it was shifted to Bangalore and then merged with the Central Handicrafts Development Centre (CHDC) of the All India Handicrafts Board. Presently, it is a part of the Regional Design and Technical Development Centre, Technical Wing, of the Office of Development Commissioner, Handicrafts. It has, over the past 20 yrs, standardised 22 shades. Using 4 different mordants, 88 shades can thus be obtained. The Gandhigram Trust near Dindigul in Tamil Nadu has also been doing yeoman service in this field over the past 22 yrs. It has developed more than 100 shades. It is, however, extremely cautious in the use of mordants and advocates minimizing its use.

Taking the second aspect of R & D and going beyond the stage of just extraction of dyes, a few entrepreneurs have succeeded in setting up industrial units for the production of standardized natural dyes in easy to use powder form, covering a wide colour range. One of the first notable examples amongst these is IIT Delhi, having pioneered the R & D work. A few commercial units are also reported to have come up. Details of methods of manufacturing of 86 dyes, which more entrepreneurs could make use of have also been reported⁹. These will also be of interest to traders, researchers and students. However, as stated earlier, one has to be selective in setting up such units.

A rough flow chart for such production systems has been presented (Fig. 10).

In such cases, proper specifications of the raw materials in terms of moisture content, ash content, water or alkali extractable matter and absorption spectra must be specified for reproducible results.

**Natural dyes**

Colours derived from nature, have a certain depth and unique characteristics not found in synthetic chemical colours, however sophisticated the formulations. Even dyes extracted from the same single plant, may vary with the age of the plant Variations in colour are inevitable, given the variable nature of the dye yielding plant product which is influenced by age, climate, soil conditions and the nature and pH of water used, etc. While these may cause difficulty in standardization, these very factors give naturally dyed textiles a special beauty and character and set it apart from synthetic dyes. Tonal variations should not be specified closely. The famous Bleeding Madras was in great demand because the colours bled and changed with every wash. With proper handling, vegetable dyes should meet ISO specifications for washing and light fastness. Another major uniqueness of the vegetable dyes is that they are eco-friendly. There is no question of their poisoning the atmosphere or causing pollution. The synthetic dyes, especially the azodyes and benzidine derivatives, have severe toxic effects, releasing harmful amines, allergens, carcinogenous and other poisonous compounds, which may cause allergy & cancer and are detrimental to human health & environment. Consequently, a decade ago, many developed countries have banned the import and stock of commodities manufactured from such azo, and benzidine based dyes. India has also followed suit and imposed a ban on more than 100 synthetic dyes and 40 pigments. Thus, the wheel has come full circle, the synthetic dyes are going out of favour and natural dyes are coming back. The very fact of these practices being continued even in today’s modern world validates them. The Indian tradition is perhaps the only one in the world, which has one foot firmly planted in a time cycle going back by thousands of years. The traditional Indian artisan lives in the villages in harmony with nature. The Indian tradition of natural dyes reflects the soul of our nation and is entirely suited to the Indian ethos. There is an urgent need to preserve, nurture and enrich this tradition of use of natural dyes (Fig. 9).
Fig. 1 Tie and dye (Gujarat)
Fig. 2 Tie and dye (Gujarat)
Fig. 3 Vegetable dyes
Fig. 4 Dye from turmeric and saffron
Fig. 5 Dye from Annato
Fig. 6 Dye from Murukambu
Fig. 7 Dye from Manjistha
Fig. 8 Dye from Indigo
Fig. 9 Natural dyes
Fig. 10 Flow chart

1. Collection of raw material
2. Size reduction
3. Batch extraction
4. Phase separation
5. Filtration
6. Evaporation
7. Drying
Marketing of vegetable dye products

Naturally dyed products are a little more expensive than a similar product using synthetic dyes. It is purchased for the sake of its aesthetic appeal to the connoisseurs. There is really no competition for market between the natural dye sector and the synthetic dye sector. Both have their own clientele. Even if the natural dyes sector expands as it must, still there will be a limit to it, because of constraints of raw material availability, transportation, region specific varieties, types and designs. The availability of plant sources for natural dyes is limited and cannot meet the demands of modern textile industry. A large volume or weight of the materials may be required to produce small quantity of the dye. It is suggested that where a raw material is not widely available in the country and is confined to some remote pockets, the dyes derived there from should be used only locally. It would not be economical to transport raw materials over long distances. It should be ensured that a balance is maintained between the products of natural and synthetic dyes. Attention has to be given to ways of bringing down the cost of natural dye product by increasing the yield of the raw materials like for instance indigo and also to the marketing side.

Conclusion

Natural dyes sector has not attracted the fancy of our modern day scientists, perhaps because there is no glamour attached to it. Also, the present suboptimal funding of R&D efforts would just not do. The Handicrafts Board and such other institutions, in spite of all their zeal in this subject may not be the right agencies for this purpose. Sporadic R&D efforts have been made in IIT Delhi, Forest Research Institute, Dehradun, etc. But a more coordinated action in the following areas is urgently necessary: identification of plant sources as raw materials and developing high yielding varieties such as in the case of Indigo; designing proper conditions and parameters for dyeing; establishing conditions for standardizing of the colour shades of dyeing to the extent possible; and design of modern units/ factories for production of vegetable dyes in the form of powder or cake. It is recommended that an institution like CSIR should take up this sector more seriously.

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