

# NATURAL DYES AS COLORANTS FOR FOOD AND TEXTILES

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**Abstract**-World has a rich biodiversity and harbours a wealth of useful germplasm resources and there is no doubt that the plant kingdom and animal kingdom is a treasure-house of diverse natural products. One such product from nature is dye. Dyes are aromatic organic compounds which induce color to the substrate by showing affinity towards it. Natural dyes are derived from naturally occurring source such as plants, insects, animals and minerals. This review is done to focus plants on natural dyes for textiles products and the plants which yield colors that can be used as natural dyes with some technical methods. As synthetic dyes develop several kinds of pollution in the environment. Likewise synthetic dyes or colourants have been banned because they cause allergical symptoms or carcinogenics. In recent years synthetic dyes though they have good aesthetic dyeing ability but the hazards caused by them have made awareness among society to look for the betterments in natural dyes as natural dyes are non-allergic, non-toxic and eco-friendly.

**Key words:** Dye yielding plants, Mordant, Natural dyes, Colorants, Textile.

## 1. INTRODUCTION

The word dye derived from Middle English termed deie and also from old English dag and dah [1]. During olden days all coloring materials were obtained naturally by extraction from barks, roots, seeds, leaves and shellfish. Natural dyes are the dyes derived from naturally occurring sources like plants, Insects, and minerals.

In the human civilization plants are used not only for the basic needs of life such as food, fiber, fuel, cloths and shelter but also as sources of natural dyes for dyeing cloths, design and painting. The most commonly used natural dye is obtained from roots of madder plant. This dye is mostly used for dyeing fabrics to obtain a Turkey red color. The sources of dye were leaflets from wood plant whereas for indigo plant the leaflets and the branches were the sources.[3]

Dyes obtained from insects also have dyeing ability. One of the good examples is a cochineal dye [4], which a brilliant red dye produced from insects is living on cactus plants. For production of dye female insects are used. These insects are collected, dried in the sun, and then beached to produce a rich, red powder dye.

Natural dyes are also obtained from minerals and one such example is Ochre. It is a natural dye available from an iron ore present, also termed as ferruginous clay. Usually red dye is obtained from ore named hematite and yellow dye is obtained from limonite.

Natural dyes are environment friendly for example, turmeric is a yellow dye of powerful antiseptic properties used to increase rejuvenation of skin, whereas indigo, a blue dye used to produce a cool sensation. Many of the natural dyes possess antimicrobial property due to the presence of tannins.

Recent resurgence in research and development on natural dye production and application is observed due to increasing popularity of more natural lifestyle based on naturally sustainable goods [5]. Natural flora/fauna is full of exquisite colors fascinating and attracting human being towards a vast portfolio of possibilities [6]. During the last few decades, increasing attention has been paid by researchers to various aspects of natural dye applications and extensive R&D in this area is underway worldwide.

## 2. LITERATURE SOURCES OF DYES

The importance of vegetable dyes has increased presently, with increased awareness about harmful effects of chemical dyes both in production and in its usage by human beings. In the light of these factors there is a very huge potential for vegetable dye and food colors, since all of them are extracted from natural sources and are having no harmful effects (Industrial Extension Bureau. Different parts of plants, animal residues and some of the minerals are the sources of natural dyes. Vegetable source of natural dyes are renewable (7) .

The natural agriculture of dye plants for the specialized natural fabric firm is as emerging a challenging sector of natural farming (8). Henna or Egyptian privet is the source of an ancient and very important yellow dye (9). Turmeric is the most commonly used yellow dye followed by harshingar (nyctanthes arbortristis) and palash (butea frondosa). Weld has been the most commonly used natural yellow color in Europe countries (10). Coreopsis,

goldenrod, onion skins give yellow color. Lilies, queen anne`s lace, rhododendrum give green color. For purples or lavenders the sources are blackberries and grapes (11).

Most of the plant materials used for the extraction of dyes are also credited with medicinal properties, and are rich in naphthoquinones (12). Few of the fabrics are dyed to brown, pecan and orange by Nut hulls. For cellulose,protein fibers Indigo act as vital blue component in the series of natural dyes. Brown from tengar, bakau, obah, durina. Red brown color can be obtained from engkerbai psychutria viridiflora reinu, mekgudu angšana (12) Yellow from the wood of asepan, bebaru, engkala burong, pedalai. Blue from tarum, indigofera. Purple from the pods of jering.

### 2.1 Advantages of Natural Dyes

The advantage of natural dyes is eco-friendly, i.e., they do not create any environmental problems at the stage of production or use and maintains ecological balance. These natural dyes are very ecofriendly and hence can be used for textiles, medicines, food coloring, cosmetics (13). Varied natural colours sink together and rarely hinder the aesthetic beauty of the results when using natural dyes. Self-sufficiency if growing your own plants for plant dyes. Not dependent on non-renewable materials. Allow for endless experimentation. Allow the reproduction of old techniques with development and updates of current view. Grow older with time and do not fade even on exposure to sunlight & normal use.

### 2.2 Disadvantages

Involves more time consumption during extraction of dye from raw materials. The resources available for natural dyes are limited and low in quantity. All the dyes cannot be produced in all the seasons; hence the availability of a particular dye depends on the season. Although natural dyes produce bright colors, but fades faster than synthetic dyes. Natural cannot be applied on synthetic fibers which are currently used on a large scale. Some natural dyes require mordant especially when used to dye cotton. Usage of mordant is toxic in nature. Highly expensive than synthetic colors.(14,15).

## 3. EXTRACTION NATURAL DYES FROM THE SOURCE

Extraction of colours from the respective component is an important step in dyeing process in textile industry to maximize the color quantity.

Dyes from different sources can be isolated through aqueous medium by using water. This can be done with or without addition of salt/acid/alkali/alcohol in the isolation bath, supercritical fluid extraction, enzyme assisted extraction, and alcoholic/organic solvent extraction. This can be done by using relevant extracting equipment or soxhlet extraction method with the use of alcohol and benzene mixture. Finally filtrate obtained subjected to evaporation and to dry using ultra filtration equipment or centrifuge rotatory vacuum pump/or by extraction under reduced pressure.

The material obtained is usually dried under shadow in air or dried in sun with a temperature range of 37-40°C for the moisture content of the source natural dye material is reduced to 10-15% with proper drying. Since, most of the material have moisture content of 40-80% and cannot be stored without drying. After drying, grinding is carried out to break down the material into very small units or preferably powder form. Extraction is defined as a process of separating the required colour component either through physical or chemical means with the help of a solvent. Most favorable conditions of isolated materials variables are identified through extracting the natural colour component from source material by differing extraction parameters of liquor and calculating the optical density of coloured liquor by using spectrophotometer. Also, the gravimetric yield of colour is calculated from filtering the extraction liquid. This is done through standard filtration process followed by evaporation of solvent, then washing and finally drying to get the pure natural colour.

### 3.1 Aqueous Extraction System

To optimize the extraction method of colour component in aqueous medium, it is dried and finely cut and grinded into powdered form. The color shall be extracted from one of the standard methods of extraction. Extraction process of dye is carried under varied conditions like time of extraction, temperature of bath in which extraction carried out, pH of extraction solution, concentration of colour-source material (powdered form of source natural dye material) and Material-to-liquor ratio (MLR). Other methods include through non aqueous solvents, acid alkali, ultra sound assisted etc.

The obtained aqueous is a crude one which is double filtered from a fine nylon mesh cloth into a sintered glass crucible. The filtrate is obtained evaporated using a vacuum oven at a lower temperature of 70°C to a semi-dried solid mass. The same is then put in a enclosure of wrapped filter paper. Further it is subjected to extraction in soxhlet apparatus using 1:1 alcohol:toluene mixture for 10 cycles for 2h at 70°C. The alcohol- toluene extract of the colour components is finally subjected to evaporation in a water bath at 50°C to get a semi-dry mass of the pure

colour components. Finally, the extracted colour substance is washed thoroughly with 100% acetone, followed by methyl alcohol wash. At final stage it is air dried to obtain the dry powder of the pure colour component of the corresponding natural dyes.

#### 4. CHARACTERIZATION OF NATURAL DYES

Chemical composition of natural dyes is identified by macro chemical analysis. Classification of natural dyes is done based on the presence of chemical group as; anthroquinone(madder), alpha naphthoquinones (henna), flavones(weld), indigoids (indigo and tyrian puple), carotenoids chemical nature of such colorants [4].

##### 4.1 UV-Visible Spectroscopic Study

UV-visible spectra of any coloring substance show its peaks at predominating wave length, representing main color. For natural mixed dyes, the peaks obtained will be specific and represent that particular colour only in both UV and visible region. UV-visible spectroscopic study of varied natural dyes was carried by using different solvents for isolation. Natural dyes reported and research done was as follows. Colour from Neem bark shows two absorption maxima at 275 and 374 nm. while beet sugar shows three absorption bands at 220,280,530 nm, red sandal wood shows a strong absorption peak at 288nm and the maximum absorption at 504 and 474nm at pH 10 in methanol solution and Gomphrena globosa flower colorants shows one major peak at 533nm. The dye obtained from this does not give much variance in the visible spectrum at pH 4 and 7, but the peak shifts towards 554nm. Although these studies too subjective in nature, they are useful to understand the UV absorbance principle, as these indicates many application information like possible fading and absorbance behavior under UV-light, sun-light, etc. Hence these reports are also important.

##### 4.2 Chromatographic Analysis

Chromatography is very important in chemistry. It is used to analyze unknown compound. Thin layer chromatography (TLC) is applicable to identify different color components in natural dyes to be applied on textiles. Dyes detected were insect dyes, and vegetable dyes. The principle applied in chromatographic analysis is from obtaining the absorption and emission of spectra by spectroscopy are subjected to quantitative analysis and identifying the red dyes, such as alizarin, purpurin carminic acid, etc. A linear gradient elution method is used for the analysis of plant and scale insect as well as for the red anthraquinonoid mordant, molluscan blue, red, purples and indigoid vat dyes. The method enables the use of the same elution program for the determination of different chemical class of dyes.

#### CONCLUSION

The organising principle for sustainability is sustainable development, which includes ecology, economics, politics, culture, social impact and human health. Less expensive production of natural dyes and affordable industrial application methods are needed. Only selected natural dyes and pigments (e.g. indigo, alizarin dyes, tannins, flavonoids) may compete with synthetic dyes for quality and stability. At the current level of world textile production, natural dyes can replace only a fraction of the total consumption of textile dyes.

Coloured waste utilisation mainly from food, beverage and timber industries is practically applicable only in limited cases, growing dye plants is particularly important when using marginal soils. Land availability for growing natural dyes is limited in view of the first preference to food and fodder crops. Some important dye plants, including madder and indigo or woad, can be cultivated on marginal and wastelands to enhance their availability. Seasonal availability of natural resources, tedious process of their processing and extraction of dyes, necessity of processing and possibly transport of large amounts of plant materials and subsequent problem with resulting waste, ineffective dye exhaustion from the dye bath, contamination of land and water resources by metallic mordants, unstable and not reproducible hues and often bad fastness together with high costs are the main reasons hindering the wider use of natural dyes in textile dyeing.

At the level where scientific developments stand today, natural dyes are a sustainable option only for small-scale applications and they can only complement synthetic dyes. They can be considered as best suitable on the cottage level, for small scale industries, manufactories, hobby groups, and craftsmen.

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