
ABSTRACT

Source of colours from natural sources have been ignored from many years. Less research is done in this field. Natural colourants are used mainly for textile dyeing. Field of application of natural colourants is restricted and market of natural colours is also less. Over the past many years, it has been observed that synthetic dyes have many disadvantages associated with them like toxicity, pollution, allergenicity etc. but natural dyes have no such disadvantages. Indian history is rich in colours from natural resources but no such database is available for exact production of colours from natural sources. In this article we review the use of natural colours from history, their field of application, their advantages and disadvantages.

KEYWORDS: natural colours, dyeing, colourants.

INTRODUCTION

For understanding the concept of natural colourants, we need to start from history. From history we concluded that concept of textile dyeing is very old. In 2600 BC natural dyes were used in China for the first time at that time, it was used for dyeing textile. During the civilization of Indus valley natural things were used for wall decoration and paintings in cave. Natural dyed clothes were used to wrap mummies in Egypt. Heena that is used to colour hairs was as old as 2500 BC. Use of blue indigo dye started from 7th century. Colours might be discovered accidentally but we cannot imagine our present day world without colour. In ancient times, method for colouring was not permanent as crushed pigments were used directly for colouring without any processing. But now colours have evolved from natural to synthetic. Synthetic colours are used in every field now days like painting, textile dyeing, glass industry, paper industry etc.

TYPES OF NATURAL COLOURANTS

Based On Their Origin

- **Plant/ Vegetable Origin**
These are the colourants derived from leaves, roots, bark, fruits, flowers, trunk of plants and vegetables either in dried or wet form produces colour. In India there are about 500 species of plants and vegetables which are found suitable to give colourants. These colourants have applications in food colouring, medicines, paper colouring etc. Examples are yellow from turmeric, red from madder roots, blue from water lily etc.
- **Insect/ Animal Origin**
These are the colourants obtained from secretion and dried bodies of insects or animals. Deep violet colour obtained from the secretion of sea mollusc, Murex is oldest known animal dye and is very expensive. Examples are lac insect secretion, urine of cow, shellfish etc.
- **Mineral Origin**
These are the colourants obtained from earth or minerals. Oxides and hydrated oxides of manganese and iron, orchers, titanium dioxide, umbers are some examples of mineral origin natural colourants.
- **Microbial/Fungal Origin**
These are the colourants obtained from bacteria, algae, fungi, and yeast upon micro-biological action. Colourants produced from these have anticancer and antioxidants properties. These are used in sauces, baby foods, milk products, energy drinks and many more. Factors such as temperature, pH, type of fermentation,

moisture content etc. affects microbial pigment production. Examples are brown from bacillus, red from *dunaliellasalina*, yellow from *ashbyagossypi* etc.

Based On Their Chemical Constituents

- **Indigoid dyes**
Most important dye of this class is indigo and is also the primary source of blue colour. Indigo obtained from *Indigofera* species is insoluble in water. For water soluble form it must be reduced to leuco form by reduction process. It is used for dyeing textiles. After dyeing, it is oxidized to blue indigotin structure which has excellent colour fastness properties. This natural indigo is similar in structure with synthetic indigo.
- **Anthraquinone**
Red colour dyes fall into this category. Alizarin, morinda, lac, indian madder and cochineal are some examples of this dye.
- **Naphthoquinone**
These dyes give red, orange or reddish brown shades. Walnut shell, henna etc. fall under this category of dyes.
- **Flavonoids**
Most of yellow coloured dyes fall under this category of dyes. Luteolin, rutin, quercitrin are some examples of this dye.
- **Dihydropyrans**
These dyes have structure like flavonoids but are substituted dihydropyrans.
- **Anthocyanidins**
Carajurin fall under this class of dye. It is obtained from *Bignonia chica*.
- **Carotenoids**
Bixin and nor bixin of annatto seeds and crocin of saffron stigma are major dyes of this class. Colour of this dye is due to presence of double bond.
- **Tannin based**
Polyphenolic compounds of tannins fall under this class. Tannin requires mordant for textile dyeing and also changes colour with different mordant. Babool and cutch are examples of this dye.

Based On Extraction Methods

Synthetic inks are made from synthetic resources through chemical reactions, but natural inks are prepared from natural resources like plants, animals, minerals, microbes and fungus. Firstly colourant from natural resources were extracted and then ink was prepared by adding suitable constituents. Extraction of colour from natural resources is a complicated process. The different methods for extraction of natural colourants are as follows:

- **Aqueous Extraction**
It is a traditional method for extracting colour from natural resources. In this method, colour containing compound if dry broken down into small pieces or in powdered form by grinding and soaked with water in vessel for some time to loosen the cell structure. If colour containing compound is in wet form then it is chopped down to fine pieces or grinded to fine paste. Then these broken down pieces are boiled in water to get the colouring component dissolved in water. This solution is filtered to separate colouring solution and non-colouring remnant. Both can be used easily to impart colour to different things. There are some disadvantages associated with this extraction method like slow process for extracting colour, high temperature requirement, large volume of water requirement, heat sensitive colouring substances gets reduced at high temperature low dye yield, only water soluble colouring components can be extracted.
- **Alkali or Acidic Extraction**
In this extraction method alkali or acidic medium is used to extract colour. In this dilute acid or alkali can also be used which helps in hydrolysis of glycosides resulting in better extraction. Alkaline medium is used for colour extraction because phenolic groups easily dissolve in alkaline medium. Colour from annatto seeds, lac insect, safflower petals are extracted using this method.
- **Microwave and Ultrasonic Assisted Extraction**
As the name suggests this extraction method uses microwave and ultrasonic rays to increase the efficiency of extraction method. In this method colour giving compound is treated with water or any other solvent in

presence of microwave or ultrasonic wave, so that higher temperature, less time and faster rate of extraction can be achieved and thus increases extraction efficiency. Extraction of colour from butterfly pea and annatto seeds can be done using this process.

- **Fermentation Extraction**

In this extraction method micro-organisms present in air or in the colouring compound are used to carry out fermentation and thus help in extracting colour. Basically micro-organisms disintegrate the colouring matter present in the substance and dissolve it in the solution in which fermentation is carried out. Extraction of colour from indigo, turmeric, annatto seeds can be carried out using this method. Long extraction time, bad smell due to microbial action, immediate extraction of colour after harvesting are some disadvantages of this method.

- **Enzymatic Extraction**

There are commercially available enzymes like cellulase, amylase, pectinase which can be used to loosen the binding materials present in natural materials like bark, roots or any hard part of plant.

- **Solvent Extraction**

Different natural colouring materials have different nature and thus have different dissolving properties. This method of colour extraction is more efficient than aqueous method. Extracted colour can be easily purified as solvents can be easily removed by distillation and reused, less degradation. Toxic residual solvent, co-extraction of chlorophyll and waxy materials are some disadvantages of this method.

- **Supercritical Fluid Extraction**

Supercritical fluid is a fluid having physical properties between gas and fluid. These have low surface tension, low viscosity and good diffusivity and thus have better interaction with the substrate. At high pressure and temperature which is required to maintain a supercritical fluid, it is easy for supercritical fluids to dissolve substances present in natural sources. High cost of equipment and poor extraction are disadvantages of this extraction method.

FIELD OF APPLICATION

- Glass industry
- Paper industry
- Textile dyeing
- Leather industry
- Hobby group
- Food industry

ADVANTAGES OF NATURAL COLOURANTS

Following are the advantages of using natural colourants:

1. Eco-friendly
2. Less pollution generation
3. Non-toxic
4. Non-allergic
5. Non-carcinogenetic
6. Easy to prepare
7. Biodegradable
8. Easy to dispose

DISADVANTAGES OF NATURAL COLOURANTS

Following are the disadvantages of using natural colourants:

1. Fugitive
2. Proper storage conditions required
3. Shades vary from batch to batch
4. Have no standard method for preparation
5. Not easily available
6. Complex process of dyeing

CONCLUSION

Field for application of natural dyes is limited. Textile industry is the main field for its application but it can also be used for paper printing, more research is required in this field to standardize the methods for its application. Extraction of colour from natural sources is also limited, more research is required in this field. Because of growing disadvantages of synthetic colours, people started using natural colours. In future it is expected that use of natural colourants will grow extensively.

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