

NATURAL COLOURANTS AND DYES FROM PLANTS ORIGIN

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ABSTRACT

Natural colourants cover all the dyes and pigments derived from the plants, insects and minerals. Natural colours have been great value for colouring food, pharmaceutical dosage form, textile products. Natural dyes were also used in clothing's, as well as in cosmetic industry (Henna, Catechu), pharmaceutical industry (Saffron, Rhubarb) and in food industry (Annatto, Cur cumin and Cochineal). As now public's awareness foreco-preservation, eco-safety and health concerns, environmentally benign and non-toxic sustainability in bioresourced colorants, have created a revolution in textile research and development. Natural colorants can be categorized into natural,synthetic,organic, inorganic origin. This review focus on natural colorants obtained from plants origin including a pharmacognastic account in detail.

KEYWORDS – natural colorants , synthetic, dyes, plants.

INTRODUCTION

Now day colour are used in every products of our day to day life. There are most of pharmaceutical formulation (tablets, capsules, ointments, tooth paste etc.) which need to use colorants.

IDEAL PROPERTIES OF COLOURANT

1. Non toxic
2. Free from any harmful impurities
3. Inexpensive
4. Readily available
5. Free from objectionable taste or odour.
6. It should have optimal solubility in water
7. In alcohol and oils solubility is desirable
8. It should remain unaffected by oxidizing or reducing agent, light, temperature, micro-organisms
9. It should be stable on storage.

Classification of colours

- 1) Organic colour or pigments and their lakes.
- 2) Inorganic colour or mineral colours.
- 3) Natural colours (plants and animals colours)

1) Organic colours

Organic colours are synthetic, chemical compound exhibiting their property when dissolve in a solvents. They are soluble in glycerine or propylene glycol. They are cheaper in cost and having high colouring power the natural pigments.

Lakes

FDA defines lakes as “aluminium salts of FD&C water soluble des extended on a substratum of alumina”.

FDA lakes are available in six basic colours,

- One yellow
- One orange
- Two red (pink-red, orange – red)
- Two blue (green-blue, royal-blue)

2) Inorganic colour or mineral colour

A great advantage of inorganic colour is widely acceptance. And drawback are it had toxic effects, they were quickly replaced by many synthetic dyes.

Ex – titanium dioxide.

3) Natural colour

Natural pigments are highly coloured substance found in many plants or animals. This is chemically and physically diverse group of materials.

Natural colorants are classified in various ways depending on,

A) Based on chemical composition or structure

- i) Anthraquinones
- ii) Anthocyanin’s
- iii) Carotenoids
- iv) Indigoids
- v) Flavonoids
- vi) Dihydropyran’s
- vii) α -naphthoquinones

Table 1: Natural colouring agents classified by chemical structures

Sr. No	Chemicalclass	Common name	Colour produced
1	Anthraquinone dyes and quinone dyes	Lac, madder, santhalin, cochineal	red
2	carotenoids	Capsicum, saffron, annato	Orange red or yellow

3	Chromene dyes	kamala	Orange - yellow
4	Flavone dyes	Cutch, tesu, dolu, marigold,	Yellow and brown
5	Indigoid	Indigo, mollusk	Blue, tyrian purple
6	Benzopyrone dyes	logwood	Purple, black
7	Iso- quinolone dyes, polyene colorants	Barberry, lycopene, gentisin	yellow
8	Naphthoquinone dyes	Henna, walnut, pitti, shikone	Brown and purple grey
9	Oxyindol glycosides	Beet root	Red

i) Anthraquinone dye :-

It contains sulfonic acid groups which are soluble in water, any group of organic dyes whose structure is based upon anthraquinone. Almost all red natural dyes are anthraquinoid, having mineral and plant origins. An example of anthraquinone of herbal origin is alizarin. Insect dyes from scales of insects such as carminic acid (carmine) are main active constituents approved as food colorant E 120.

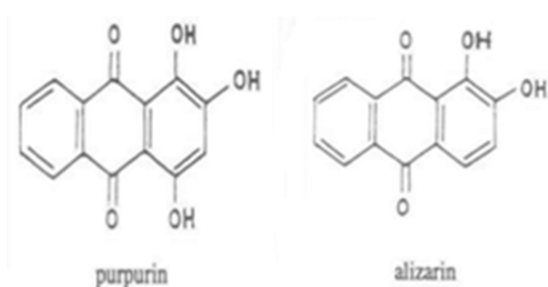
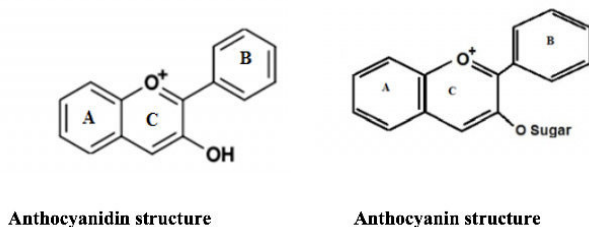


Fig: Example of anthraquinone dyes

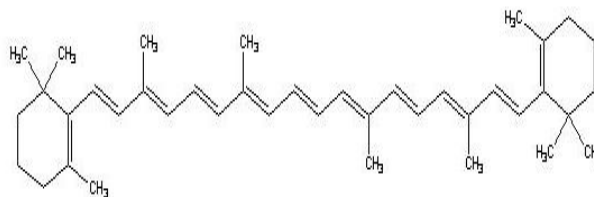
ii) Anthocyanin's :

Anthocyanins are water-soluble pigments responsible for red, purple, and blue colors in fruits and vegetables. pH, light, and temperature influence the stability of color. When pH increases, red changes to blue. Examples of this class include carajurin, a direct orange dye for wool and cotton. Anthocyanidins are present in all tissues of higher plants, including leaves, stems, roots, flowers, and fruits.



iii) Carotenoids

These are yellow, orange, red colour pigment containing conjugated polyenetetra-terpenes widely present in plant's and animals. This class contain more than 750 naturally occurring pigments.



β -carotene

iv) Indigoids

This is oldest dye. Indigo powder a blue dye extracted from leaves of indigo plant. It contain broad range of colour spectrum from orange to black. Apart from colorant, indigo used as anticancer, astringent, anti-inflammatory, antiulcer agent.

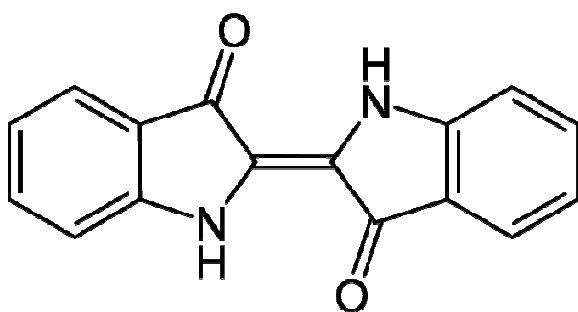


Fig: indigo structure and plant.

v) Flavonoids

This are yellow dyes classified chemically as flavones, isoflavones, chalcones, and aurones. Flavonoids have been used for natural lake organic pigment, cosmetic, pharmaceutical industries. In recent years, it has been suggested to use flavones in textile dyeing, cosmetic.

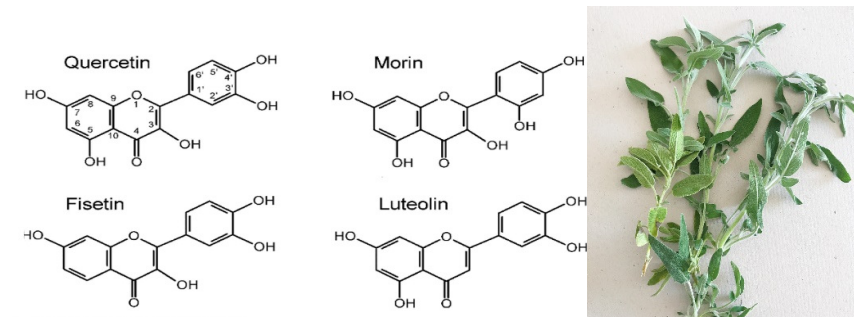


Fig: example of flavonoids and plant.

vi) Dihydroxyans

This class are chemically related to flavones. These are useful for dark shade on silk, cotton, wool.

vii) α -naphthoquinones

These dyes are generally dispersing dyes and gives shades of orange.

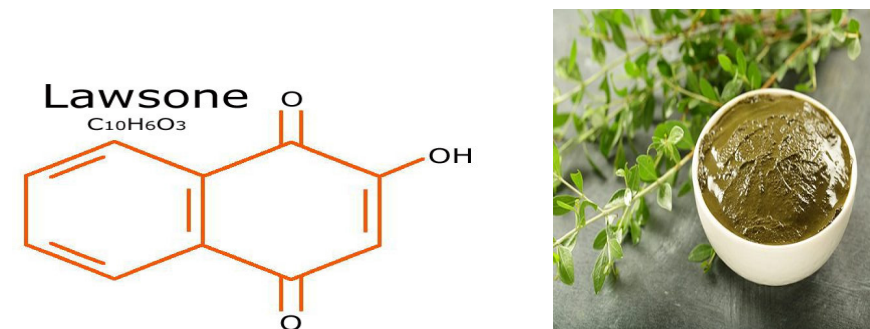


Fig: structure of lawsone& henna plant.

B) classification based on colour or hues.

In colour index, dyes are classified as chemical classes or major application classes. Primary, secondary, intermediate hues used in mixing pigments. Red, yellow, blue are primary hues. Violet, orange, green are

secondary hues. Mixing of primary and secondary called intermediate hues.

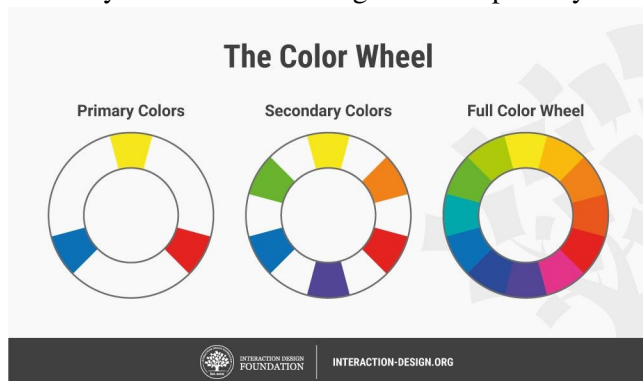


Table : List of dyes in each hue as per the colour index

C.I Natural	No. of dyes	Percentage %
yellow	28	30.4
orange	6	6.5
red	32	34.8
blue	3	3.3
green	5	5.5
brown	12	13.0
black	6	6.5

Somenatural colouring agent

***Animal derived dyes**

Dyes extracted from insects and invertebrates called animal dyes. Red and purple shades were obtained from animal origin

- Cochineal insect(Red)
- Cow urine (Indian yellow)
- Lac insect (red, violet)
- Murex snail (purple, indigo blue)
- Octopus/ cuttlefish (sepia, brown)

*** Plants derived dyes**

Plant derived dyes are obtained from different parts of plants such as leaves, flowers, fruits, pods, bark etc. These dyes can be applied directly or with different mordants

- Catechu (brown)
- Gamboge tree resin (dark mustard yellow)
- Chestnut hulls (peach to brown)
- Himalayan rhubarb root(bronze , yellow)
- Indigofera leaves (blue)
- Kamala seeds pod(yellow)
- Madder root(red, Pink, orange)
- Mangosteen peel(green, brown, purple, crimson, dark brown)

- Myrobalan fruit (yellow, green)
- Pomegranate rind (yellow)
- Teak leaf (crimson to marron)
- Weld herb (yellow)
- Juglans nigra or black walnut hulls (brown, black)
- Rhus typhina (brown).

***Mineral derived dyes**

The dyes which are extracted from mineral source called mineral dyes. The dyes obtained from mineral source may be poisonous and hence not being used commercially.

- Iron (yellowish brown)
- Prussian blue(blue)
- Chrome yellow (yellow)
- Manganese brown(brown)

Pharmacognosy account of natural colouring agent

Sr . No	Natural colouring agents	Biological source	Family	Chemical constituents	Pharmaceutical uses
1	Cochineal (anthraquinonecolourants)	Cochineal consist of dried bodies of female insect of species <i>Dactylopiuscoccus costa</i>	Coccidae	Cochineal is potassium salt of carminic acid, glycerol myristate and coccerin resent in cochineal insect.all known pigments of scale insects are polyketideanthraquin ones.	Cochineal & carmine used as colouring agent for liquid and solid preparation of foods, drugs and cosmetics. Carmine used as colourant in lipsticks.
2	Henna (quinoline&anthraquinoline)	Fresh or dried leaves of the plant <i>Lawsoniainermis lam.</i>		Lawsone (0.5-1.0%), gallic acid, white resin , tannin, xanthones.	To dye hair and skin, anti-inflammatory, analgesic, antipyretic.

3	Annatto	Extracted from outer coatings seeds of <i>bixa Orellana L</i>	bixaceae	Bixin, norbixin, some terpenes, tocotrienols, arenes, flavonoids.	Bixin used in production of coloured coating material in solid pharmaceutical dosage form.
4	Indigo	It mainly obtained from <i>Indigoferatincteria</i>	Leguminosae	Rotenoids, deguelin, rotenol, rotenone, tephrosin, sumatrol	As colourant in pharmaceutical dosage form
5	Beet root (Indolecolourant)	It consist of red beet root, <i>beta vulgaris</i>	Amaranthaceae	Betain, betalains, betanidine, glucose	Nontoxic food and pharmaceutical and cosmetics colourants
6	Turmeric (warm gold colour).	It consist of dried , fresh rhizomes of plant <i>curcuma longa linn</i>	Zingiberaceae	5 % volatile oil, resin, curcumin, volatile oils, starch, curcuminoids, cineol	Antioxidant, anticancer, anti-
7	Marigold (bright orange , yellow)	Mary gold or scotch marigold flowering plants	Asteraceae	Triterpene, saponin(2-10%), menthone, hydroxycoumarin, carvone , cartenoids	Heals asking wounds, burns , cancer, menstrual pain
8	Tea (rich earthy color)	Prepared leaves and leaf buds of <i>Thea sinensis</i>	Theaceae	Caffeine, volatile oil, tannin, xanthine, theophylline	Antioxidant, help to weight loss, protect your bones
9	Onion (orange or purple hue)	<i>Allium cepa</i> , vegetable that most widely cultivated species of genus <i>allium</i>	Amaryllidaceae	Allicin, fisetin, quercetin, sulphur compounds	Antioxidants, help control blood sugar, antibacterial

10	Avocado(purple)	Alligator pear, member of flowering plants	Lauraceae	Fatty acids, vit A, E,C, B6, Sodium, Potassium	Rich folate source, high in fiber, great source of potassium
11	Pomegranate(golden yellow)	Fruit bearing deciduous shrub of punica granatum	Lythraceae	Gallotannins and their derivative, ellagitannins	Prevention and treatment of several types of cancer, Rheumatoid arthritis, improves wound healing
12	Carrot (fabric orange)	Daucus carota are root vegetables	Apiaceae	Fat, carbohydrates, protein, calcium.	Vit A deficiency, prevent cancer, obesity.
13	Lac insect(deep red)	Resinous secretion of no of species of lac insects, cultivated from kerria lacca	Coccoidea	Resin 68-90%, dye, wax, mineral matter	Polishes , Inka, electrical insulation, cosmetics, lubricants.
14	Saffron(yellow colour)	Saffron is dried stigma and styletops of Crocus sativus Linn	Iridaceae	Crocin, safranal, pictocrocin, crocetin, 10% moisture, dextrins	Depression, anxiety, menstrual cramps, Alzheimer's disease.

Extraction method for natural colorants

Extraction defined as separation of medicinally active portion of plant or animal from inactive components by using selective solvents in standard extraction procedures.

Natural dyes contain only a small percentage of colouring matter with along impurities such as water insoluble fibers, carbohydrates, protein and tannin. Extraction is necessary for preparing purified natural dyes. Extraction of natural dyes is complex process .

Different methods of extraction of colouring material are-

1. Aqueous extraction
2. Microwave assisted extraction
3. Ultrasound assisted extraction
4. Fermentation
5. Enzymatic extraction
6. Solvent extraction
7. Super critical fluid extraction

1) Aqueous extraction

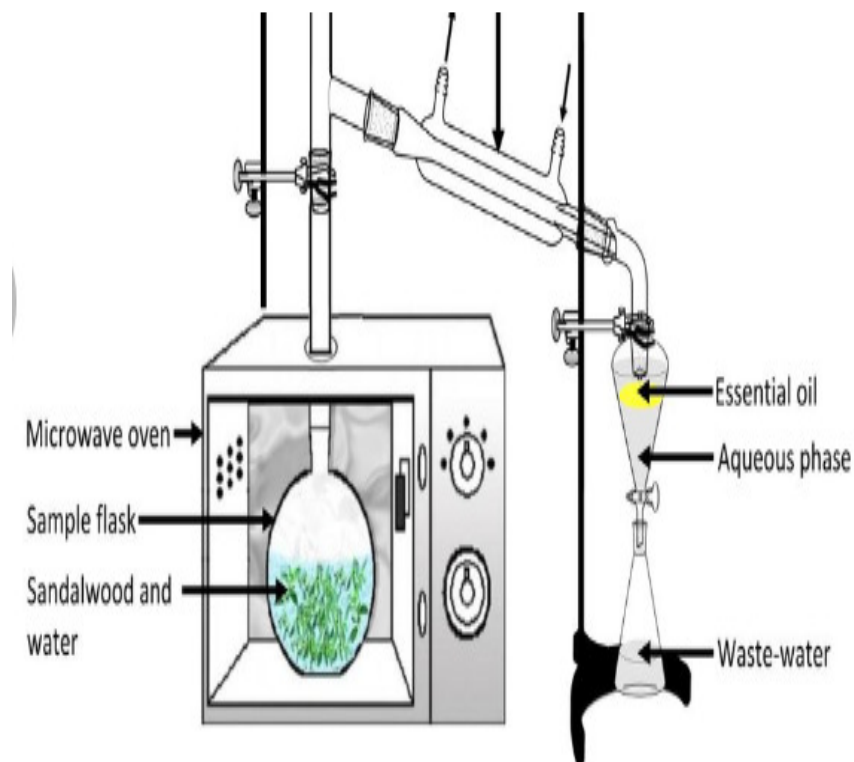
Aqueous extract of plants are simple , eco-friendly, economical. Any type of plant leave with water using simple blender to grind the dried leaves with water, centrifuges to eliminate solid waste, filter, to have aqueous extract, stored at 40°C.

2) Microwave assisted extraction

Microwave assisted extraction is an extraction for deriving natural components from raw plant material. MAE is conventional techniques for extraction of active component from medicinal plant using microwave energy to heat solvents containing samples.

Dried plants contain microscopic trace of moisture serve as target for microwave heating. High temperature and pressure is generated inside the oven . Two types of commercially available microwave assisted extraction system- a) closed extraction vessels.

b) focused microwave ovens.



3) Ultrasound assisted extraction

UAE is used in this it is rapid and effective extraction techniques , uses ultrasound to generate rapid movement of solvents , in higher mass transfer speed and acceleration of extraction. This process involves application of sound energy at high frequency greater than 20 KHz to disrupt plant cell and increase drug surface area for solvent penetration .In this method plant material should dry, grinded into fine powder sieved properly. Sample prepared and mixed with appropriate solvent and packed into ultrasonic extractor.

4) Soxhlet extraction

This process is called continuous hot extraction.The apparatus is made up of glass. It part consist of RBF, extraction chamber , siphon tube, condenser at top . Finely powdered plant material placed inside porous bag made up of a clean cloth or strong filter paper and tightly closed. Solvent is poured into bottom flask, followed by thimble into extraction chamber, solvent is heated , evaporates and passes through condenser , where it condenses and extracts the drug by coming in contact. When level of solvent in extraction chamber reaches top of siphon solvent and extracted plant material flow back to flask. The entire process continues until drug is completely extracted .

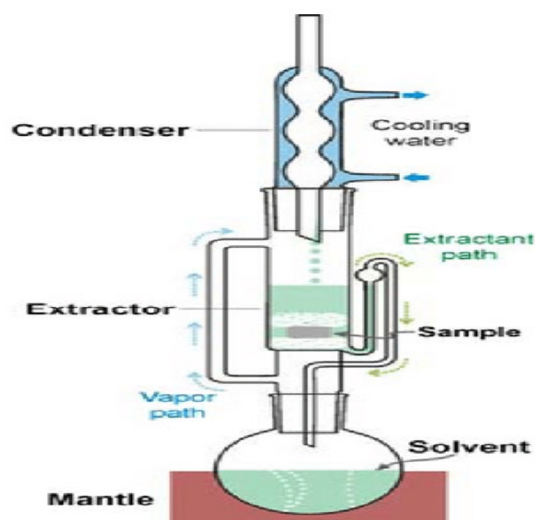


Fig- schematic representation of Soxhlet extraction apparatus

Conclusion

Natural dyes are not only demanded in textile industry but also in cosmetics , leather, food pharmaceuticals. Non toxic properties and less side effects of natural colorants from plants showing the not only because of colour but also they have different medicinal properties. 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 use of natural colorants will grow extensively.

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