Seminar report

BIO-COLOURS FROM ORNAMENTALS

By

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DECLARATION

I, Reshma Shaji (2018-12-031) declare that the seminar entitled **“Bio-colours from ornamentals”** has been prepared by me, after going through various references cited at the end and has not been copied from any of my fellow students.

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CERTIFICATE

This is to certify that the seminar report entitled "Bio-colours from ornamentals" has been solely prepared by Reshma Shaji (2018-12-031) under my guidance and has not been copied from fellow students.

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BIO-COLOURS FROM ORNAMENTALS

1. INTRODUCTION

Our world is awash with colour. Colours are present all around us and are involved in every aspect of our life. It can evoke different feelings and responses in people, that is why it matters so much. Every individual has his own choice and liking for colour. As a powerful form of communication, colour is irreplaceable. Red colour depicts the power, control, motivation and love; the blue conveys the message of trust, peace and sincerity; the green signifies the colour of life, growth, health and prosperity; while white conveys the freshness, purity and tranquillity; thus it is hard to imagine a life without colours.

Colours are well-known since ancient time for the colouration of food, textiles, medicine, cosmetics and handicraft items; also in leather processing and other fields. In earlier days, colours were derived only from natural sources. After the accidental discovery of mauve, a synthetic colour, by William Henry Perkin in 1856 and its subsequent commercialization, natural colours were almost forgotten and disappeared. Synthetic dyes and colours dominated natural ones and was readily accepted because of its distinct advantage over the latter with respect to application, colour range and availability. However, research has shown that synthetic dyes are suspected to release harmful chemicals that are allergic, carcinogenic and detrimental to human health.

Driven by the need of finding eco-friendly and less hazardous pigments than synthetic colours, there is an increasing trend towards their replacement with bio-colours. The word 'bio-colour' consists of two words bio means natural and colour means anything which is used for colouring purpose. Bicolour is any dye or pigment obtained from any vegetable, animal or mineral, that is capable of colouring food, drugs, cosmetics or any part of human body (Sharma, 2014). These natural colours come from variety of sources such as plants, algae, insects, fungi and animals.

Horticultural crops are considered as rich source of pigments and are commercially exploited worldwide for extraction of colours. Flower crops are one of the potential sources of pigments among horticultural crops.

2. HISTORY

Man has always been interested in colours; the art of dyeing has a long past and many of the dyes go back into prehistory and it has been found to be practiced during the Bronze Age in Europe. The earliest written record of the use of natural dyes was found in China dated 2600 BC. Dyeing was known as early as in the Indus Valley period (2500 BC); this knowledge has been substantiated by findings of coloured garments of cloth and traces of madder dye in the ruins of the Indus Valley Civilization at Mohenjodaro and Harappa (3500 BC).

In Egypt, mummies have been found wrapped in dyed cloth. Chemical tests of red fabrics found in the tomb of King Tutankhamen in Egypt showed the presence of alizarin, a pigment extracted from madder. In more modern times, Alexander the Great mentioned about finding purple robes dating to 541 BC in the royal treasury when he conquered Susa, the Persian capital.

Henna was used even before 2500 BC, while saffron was mentioned in the Bible. In the prehistoric times man used to crush berries to colour mud for his cave paintings. Primitive men used plant dyestuff for colouring animal skin and to their own skin during religious festivals as well as during wars. They believed that the colour would give them magical powers, protect them from evil spirits and help them to achieve victory in war.

Some of the well-known ancient dyes include madder, a red dye made from the roots of the *Rubia tinctorum* L., blue indigo from the leaves of *Indigofera tinctoria* L., yellow from the stigmas of the saffron plant (*Crocus sativus* L.) as well as from turmeric (*Curcuma longa* L.).

3. SOURCES OF BIO-COLOUR FROM ORNAMENTALS

In this 21stcentury, a global awareness is already in place favouring the use of natural resources for protecting the environment of the earth from pollution and ecological imbalances. The present scenario is focused more towards the utilization of the vast diversity of natural resources for our sustainable life. Plants are the main source of colour and there are more than 300 species which yield colours. India is endowed with rich plant wealth and has a great potential to cope with a major portion of the world demand. The availability of a wide range of climatic conditions is highly conducive for growing a wide variety of plants. The flowers, fruits, seeds, leaves, stem, bark, wood and roots of numerous plants contain appreciable amount of colours (Figure 1).

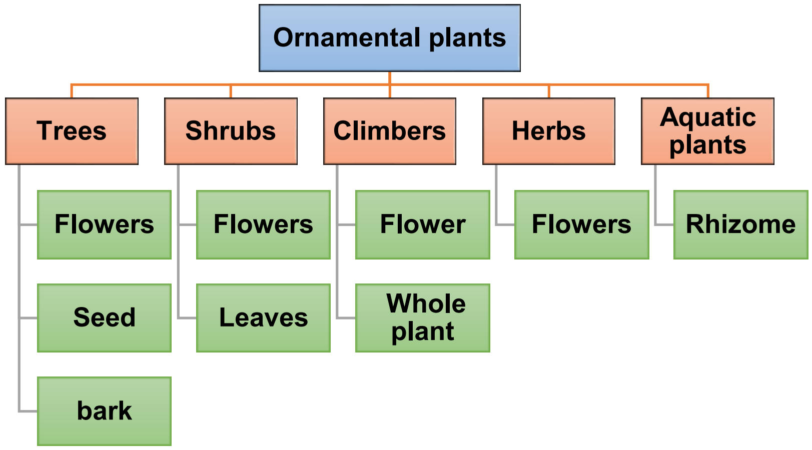

Figure 1: Sources of bio-colours from ornamental plants

3.1 Plant sources identified for extraction of colour

Some of the ornamental plants identified as potential source of bio-colour are given below. (Vanker, 2000, Shiva, 2007, Patil *et al*., 2012 and Gogoi *et al*., 2019)

3.1.1 Trees - Flowers as source of colour

Bauhinia variegata- Brown

Spathodea campanulata - Orange, yellow

Delonix regia -Yellowish red

Butea monosperma- Brilliant yellow

Nyctanthes arbor-tristis - Yellow orange

Plumeria rubra- Reddish pink/ Green/Gray

Plate 1

3.1.2 Trees - Seeds as source of colour

Bixa orellana-Yellow/Orange/Red

Plate 2

3.1.3 Trees - Bark as source of colour

Acacia arabica- Black

Ficus religiosa - Brown

Bauhinia racemosa - Light green

Plate 3

3.1.4 Shrubs - Flowers as source of colour

Celosia argentea var. cristata - Yellowish Brown

Helianthus annus -Yellow

Hibiscus rosa-sinensis - Red

Ixora coccinea -Dark red

Bougainvillea glabra - Pink

Hibiscus sabdariffa - Pink,brown and violet

Plate 4

3.1.5 Shrubs - Leaves as source of colour

Lawsonia inermis - Yellow

Indigofera tinctoria - Blue

Plate 5

3.1.6 Herbs - Flowers as source of colour

Calendula officinalis -Yellow

Gomphrena globosa - Purple

Tagetes erecta - Yellow

Dahlia species - Orange

Solidago spp. - Yellow

Cosmos sulphureus - Orange

Plate 6

3.1.7 Climbers

Flower

Clitoria ternatea - Blue

Whole plant

Rubia cordifolia - Red-brown

Plate 7

3.1.8 **Aquatic plant** - Rhizome

Nymphaea sp. - blue

Plate 8

4. EXTRACTION METHODS

The different methods for extraction of colouring materials are (Saxena *et al*., 2014):

- Aqueous extraction
- Alkali or acid extraction
- Microwave and ultrasonic assisted extraction
- Fermentation
- Enzymatic extraction
- Solvent extraction
- Super critical fluid extraction

4.1 Aqueous extraction

In this method, the dye-containing material is first broken into small pieces or powdered and sieved to improve extraction efficiency. It is then soaked in water in earthen, wooden, or metal vessel (preferably copper or stainless steel) for a long time, usually overnight, to loosen the cell structure and then boiled to get the dye solution which is filtered to remove non-dye plant remnants. The process of boiling and filtering is repeated to remove as much dye as possible. e.g.: Extraction from *Butea monosperma*

4.2 Alkali or acid extraction

As many dyes are in the form of glycosides, these can be extracted under dilute acidic or alkaline conditions. The addition of the acid or alkali facilitates the hydrolysis of glycosides resulting in better extraction and higher yield of colouring materials. Extraction from *Butea monosperma* can be done using acid extraction. Alkaline extraction is suitable for dyes having phenolic groups as they are soluble in alkali, which improves the dye yield. Dyes can be later precipitated by the use of acids. e.g.: Extraction from *Bixa orellana*.

4.3 Solvent Extraction

Natural colouring materials depending upon their nature, can also be extracted by using organic solvents such as acetone, petroleum ether, chloroform, ethanol, methanol, or a mixture of solvents such as mixture of ethanol and methanol, mixture of water with alcohol, and so on. The water/alcohol extraction method is able to extract both water-soluble and water-insoluble substances from the plant resources. The extraction yield is thus higher as compared to the aqueous method as a large number of chemicals and colouring materials can be extracted. Purification of extracted colour is easier as solvents can be easily removed by distillation and reused. Extraction is usually performed at a lower temperature which reduces the chances of degradation.

Sharief (2013) extracted carotenoid and anthocyanin from four ornamental plants *Caesalpinia pulcherrima, Cassia fistula, Clerodendrum paniculatum* and *Delonix regia* using solvent extraction after fermentation and pre-treatment with NaOH. Hexane: octane mixture (7:3) was used as solvent. Maximum oleoresin yield was found in solvent extraction after fermentation (Figure 2). Highest carotenoid yield was observed in *Cassia fistula* and highest anthocyanin yield was in *Clerodendrum paniculatum* (Figure 3).

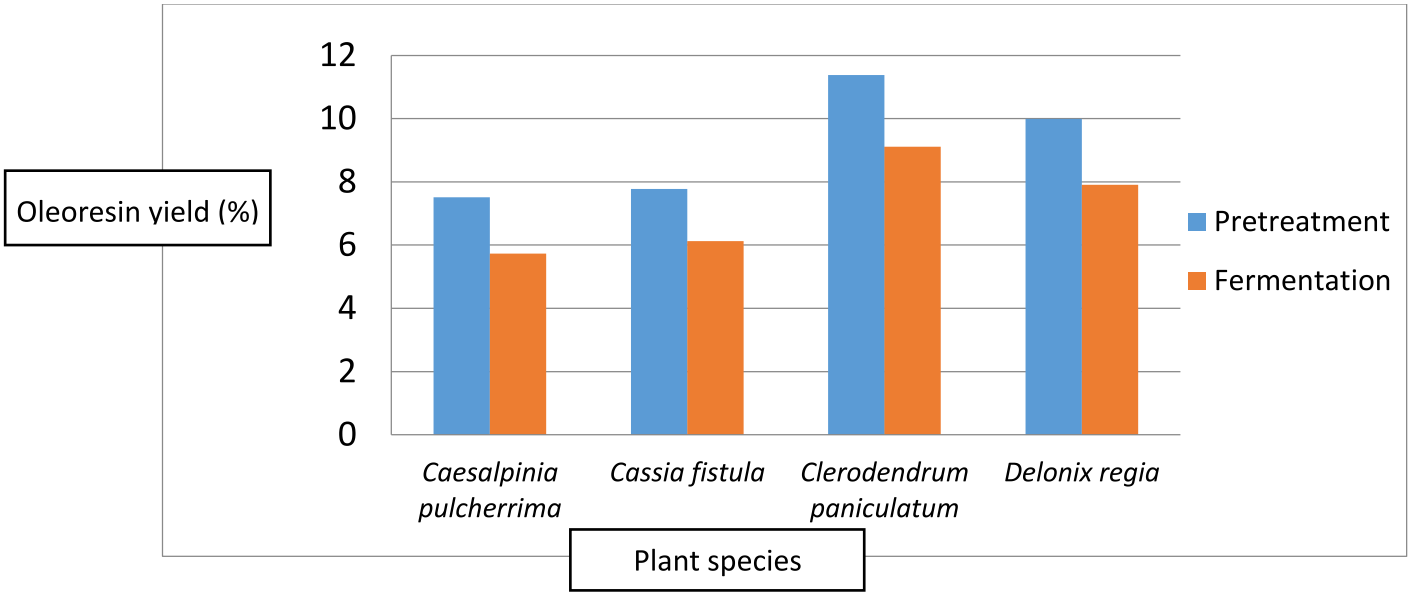

Figure 2: Yield of oleoresin using solvent extraction after fermentation and pre-treatment with NaOH

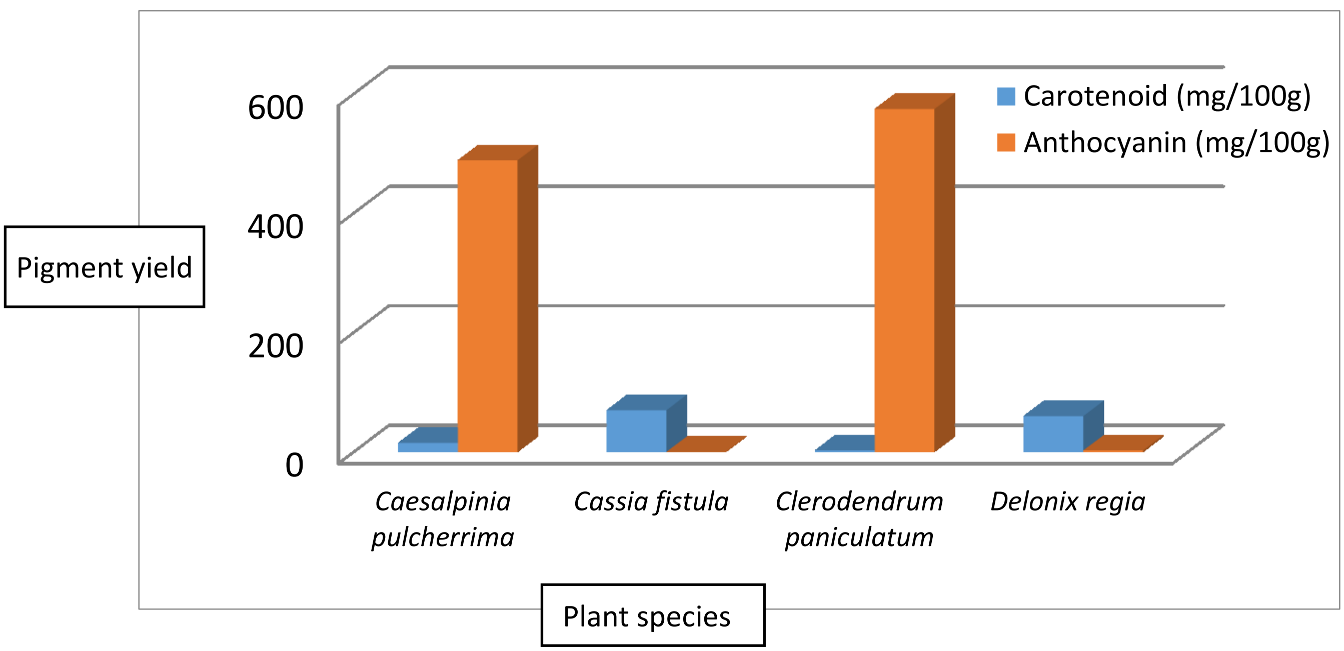

Figure 3: Yield of carotenoid and anthocyanin from four ornamental plants

Another experiment was conducted using steeping method of solvent extraction at ambient conditions, with six treatments, to extract the colour from *Butea monosperma* flower. The time of extraction, dry dye recovery and dry dye colour content were measured for each treatment after extraction. The results of dry dye recovery, dye colour content and extraction time, indicated that the 50% v/v methanol solvent has recovered highest dry dye of 0.310g per 100g flower and dye colour content of 179.25ppm (Table 1) compared to other treatments consistently with considerable extraction time of 22h 45 min.(Pandit *et al*., 2016)

Table 1: Extraction time, dry dye recovery and dry dye colour content measured for different solvents

Treatment	Extraction time (hour)	Dye recovery (%)	Dye content (ppm)
T_1 (Normal tap water)	35.13	0.279	110.135
T_2 (Reverse osmosis water)	34.75	0.273	119.625
T_3 (Methanol 100%)	21.63	0.284	139.475
T_4 (Methanol 50%)	22.45	0.310	179.25
T_5 (Ethanol 100%)	23.75	0.278	125.363
T_6 (Ethanol 50%)	27.23	0.279	163.95

4.4 Ultrasonic and Microwave Extraction

These are actually microwave and ultrasound-assisted extraction processes where extraction efficiency is increased by the use of ultrasound or microwaves, thus reducing the quantity of required solvent, time and temperature of extraction. When the natural dye containing plant materials is treated with water or any other solvent, in the presence of ultrasound, very small bubbles are formed in the liquid. These increase in size but upon reaching a certain size, they cannot retain their shape. When this happens, the bubbles burst creating high temperature and pressure. Millions of these bubbles form and collapse every second. The creation of very high temperature and pressure during extraction increases the extraction efficiency within a short time. Also the process can be performed at lower temperature and therefore extraction of heat-sensitive dye molecules is better.

Sinha *et al*. (2012) conducted a comparative study for extraction of blue dye from butterfly pea (*Clitoria ternatea*) using conventional technique and microwave technique. It was found that extraction of dye from butterfly pea employing microwave irradiation, was completed in 2 minute with 4.605 mg/L dye extract in solution (Table 2). On the other hand, it required 3 hours for yielding the same blue dye using the conventional method (aqueous extraction).

Table 2: Comparison between conventional technique and microwave technique for extraction of blue dye from butterfly pea (*Clitoria ternatea*)

Weight of flower (g)	CONVENTIONAL METHOD			MICROWAVE METHOD		
	Absorbance (nm)	Total dye in solution (mg/L)	Product condition	Absorbance (nm)	Total dye in solution (mg/L)	Product condition
0.1	515	0.2169	unclean	617	0.2847	clean
0.2	691	0.3482	unclean	1135	0.4783	clean
0.5	1315	0.7775	unclean	1890	1.230	clean
1.0	2022	1.373	unclean	3985	4.605	clean

4.5 Enzymatic Extraction

Enzymatic extraction is done using both natural and artificial enzymes. The natural enzymes produced by the microorganisms present in the atmosphere or those present in the natural resources is used for assisting the extraction process. The microorganisms disintegrate the colouring matter binding substances in the natural way. Indigo extraction is the most common example for this type of extraction.

As plant tissues contain cellulose, starches, and pectins as binding materials, commercially available enzymes including cellulase, amylase, and pectinase have been used by some researchers to loosen the surrounding material leading to the extraction of dye molecules under mild conditions. This process may be beneficial in the extraction of dye from hard plant parts such as bark and roots.

4.6 Supercritical Fluid Extraction

Supercritical fluid extraction is an emerging method in natural product extraction and purification. A gas functions as a supercritical fluid above its critical values of temperature and pressure and has physical properties somewhere between those of a liquid and a gas. A supercritical fluid is able to dissolve many substances like a liquid, as solubility of a substance in any solvent is higher at higher pressure and temperature and such conditions are needed to maintain a gas in the supercritical state. Supercritical fluid extraction using carbon dioxide (CO_2) is a good alternative to solvent extraction as it is nontoxic, cheap, easily available, and does not leave residues. Pigment from annatto can be extracted using this method.

5. APPLICATIONS OF BIO-COLOUR

5.1 Food industry

Colour is an important attribute as well as selection criterion when it comes to food choices; it enhances the appeal towards foods, thus influencing preference, pleasantness and acceptability of food products. Colour is the most outstanding parameter by which the quality of food and flavour are judged. The use of food colours to make food more attractive and appetizing has been in practice for centuries. Possible reasons for use of colorants in food substances are enumerated here (Rymbai *et al*., 2011).

- To maintain the original food appearance even after processing and during storage
- To assure the colour uniformity for avoiding seasonal variations in color tone
- To intensify normal colour of food and thus to maintain its quality
- To protect the flavour and light susceptible vitamins making a light-screen support and
- To increase acceptability of food as an appetizer

Some commercially used natural food colour

A yellow to orange colour is being used for over two centuries, mainly for colouring dairy products especially cheese, which is derived from the outer layer of seeds of the tropical tree *Bixa orellana*. The chief colouring principles are the carotenoid, bixin and norbixin. Another pigment is carotenoid extract from *Tagetes* spp. which are yellow to orange red in colour and are a rich source of lutein.

Natural edible colour was extracted by Nisa *et al*., (2018) from *Tagetes erecta* and gave lemon yellow colour shade which when applied on candies increased the attractiveness. The spectrophotometric analysis at 474nm of extracted colour both in crude form and in candies was found to be stable at 4oC and showed decay in mean lutein concentration at higher temperatures *i.e*. 25^0C and 45^0C. The microbiological study of the extracted colour and candies prepared in laboratory and dyed with *T. erecta* extract colour showed that the colour extracted from *T. erecta* itself do not promote microbial growth rather it has antibacterial activity.

5.2 Textile industry

A renewed international interest has arisen in natural dyes due to increased awareness of the environmental and health hazards associated with the synthesis, processing and use of synthetic dyes. Textile processing industry is one of the major environmental polluters as the effluent from these industries contains a heavy load of chemicals including dyes used during textile processing**.** In view of environment and human health protection, natural dye from plants is now becoming more popular. Following are different dyes obtained from ornamentals used in textile industry (Saxena *et al*., 2014):

5.2.1 Blue Dyes

Indigo is the only important natural blue dye. Leaf of the plant *Indigofera tinctoria* is the best source of this dye. This very important dye popularly known as the ‘‘King of natural dyes’’ has been used from ancient times till now for producing blue colour and is, today the most popular for denim fabrics. *Isatis tinctoria, Acacia nilotica, Nymphaea alba* are other sources of blue dye.

5.2.2 Red dyes

Madder is the red colour producing natural dye from the plants of various *Rubia* species. The dye is obtained from the roots of the plant. It is also popularly known as the "Queen of natural dyes". The main colouring constituent of European madder *Rubia tinctorum* is alizarin**.**

A red dye is obtained from the wood of *Caesalpina sappan,* a small tree found in India, Malaysia, and the Philippines which is known as sappan wood or ''Patang.'' Aqueous extraction method can be used to extract the dye. Alkali extraction deepens the red colour.

5.2.3 Yellow Dyes

Marigold (*Tagetus* spp.) is a bright yellow flower yielding plant. The flame of the forest (*Butea monosperma*) tree, produces bright orange colour flowers. The dye extracted from the flowers can be used for dyeing all natural fibers. Bright yellow to brown and orange colours can be produced with suitable mordant. Annatto and saffron are other sources of yellow dyes.

5.2.4 Brown and Black Dyes

Catechu or cutch obtained from the heartwood of *Acacia catechu* is used to dye cotton, wool, and silk to brown colour directly. It is also rich in tannins and can be used to get black colour with iron mordant.

Famous logwood black colour having very good fastness properties was obtained by using iron mordant and the extract of logwood was obtained from the heartwood of the tree *Haematoxylon campechianum* found in Mexico and the West Indies.

5.2.5 Mordanting

Textile fibers, especially cellulose, do not have much affinity for the majority of the natural dyes; hence these are subjected to an additional step known as mordanting. Mordants are the substances that have affinity for both textile fibers and dyes, thus they act as a link between the fiber and dyestuff. Those dyes that do not have affinity for a fiber can be applied by using mordants.

5.2.5.1 Metallic mordants - Metal salts of aluminum, chromium, tin, copper, and iron were being used as mordants by traditional dyers. But now, alum and iron are considered ecologically safe mordants as they are naturally present in the environment in large amounts.

5.2.5.2 Oil mordants - In the past, castor and til (sesame) oils were used as mordants but they were later replaced by Turkey Red Oil (TRO) which is sulphonated castor oil.

5.2.5.3 Tannins - Tannic acid or tannins are used as a primary mordant for cotton and cellulosic fibers as they do not have much affinity for metallic mordants. A cotton fabric treated with tannic acid can absorb all types of metallic mordants.

A study was conducted by Purohit *et al.* (2007) to develop multiple natural dyes from *Delonix regia* (Gulmohar). Dyes were prepared from different parts of gulmohar flowers and were applied on silk fibre. Different shades were achieved on fabrics using different mordants (Table 3).

Table 3: Different shades achieved on silk using different flower parts and different mordants

Sl. No	Parts of flower (*Delonix regia*)	Extraction time	Mordant	Shades
1	Whole flower	3h	Turmeric powder	Golden yellow
2	Whole flower	6h	10% alum	Olive green
3	Petal	3h	Turmeric powder	Dark tan
4	Petal	3h	10% alum	Olive green
5	Petal	3h	Without mordant	Saddle brown
6	Petal	6h	10% alum	Olive green
7	Petal + reproductive organ	3h	Without mordant	Dark brown
8	Petal + reproductive organ	6h	Turmeric powder	Brown
9	Calyx	6h	Without mordant	Brown

5.3 Leather industry

Natural dyes are also useful for leather dyeing. The results of leather dyeing with natural dyes by using different mordants were found encouraging in terms of their colour, fastness to light, rubbing, washing and perspiration properties. Pervaiz *et al*. (2016) selected four different varieties of flowers for dye extraction. They analyzed the colour shades by the application of *Celosia cristata, Lantana camara, Rosa damascena* and *Tagetes erecta* dyes on goat leather. Eco-friendly dyeing procedure was adopted for dye extraction. Forty shades were developed with ten different mordants using pre-mordanting method and four shades were obtained without mordants (Figure 4).

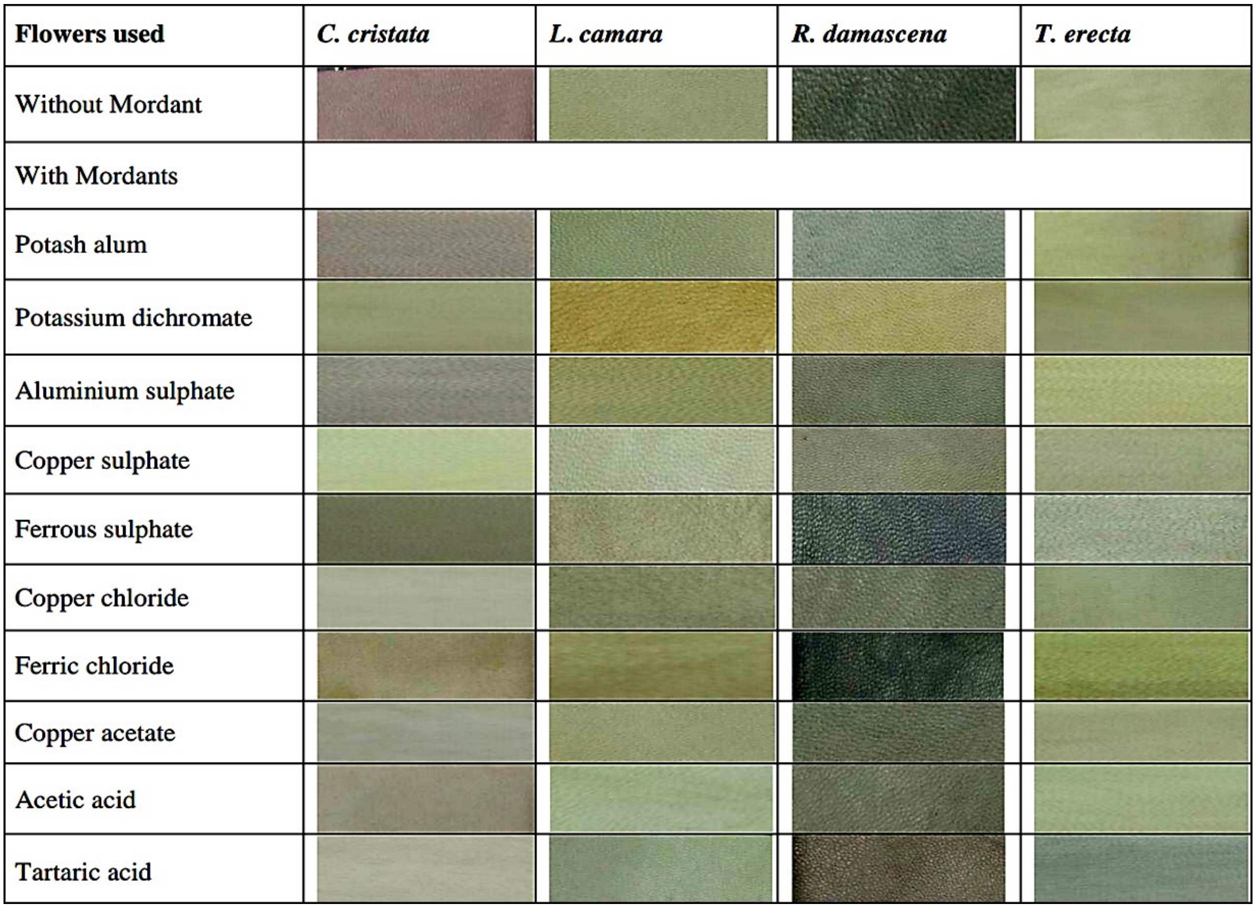

Figure 4: Shades of different colours obtained with mordant and without mordant

An experiment was conducted by Jothy (2008) to study the use of an extract isolated from marigold as a natural dye. The dye potential of the extract was evaluated by dyeing, using the flower, in 100 % cotton and silk fabrics under normal dyeing conditions and studied dye ability, wash fastness, light fastness, and colour hue of marigold dye. The surface colour was not affected by washing, and the quality of the colour was maintained even washing at 60 ^{0} C for 30 minutes. Studies have indicated that the change of some of the colours have been noticed after washing with soap and revealed that the extract of marigold flower can be used for coloration of !00 % cotton, silk, and wool fabrics.

5.4 Pharmaceutical industry

Food dyes are largely used in the process of manufacturing pharmaceutical products. The aim of such a procedure is not only to increase the attractiveness of products, but also to help patients distinguish between pharmaceuticals. The most commonly used colours in pharmaceutical products are annatto and curcumin.

Bhadkariya *et al*. (2012) conducted a study to investigate the suitability of *Butea monosperma* flower extract as colouring agent for pediatric syrup instead of tartrazine, which has been found to be carcinogenic. A 5% w/v methanolic solution as well as a 5% w/v aqueous solution was used for solvent extraction. These extracts were placed on agar plates streaked with *Escherichia coli, Proteus vulgaris* and *Klebsiella pneumonia.* The plates were then incubated for 24 hours at 37°C, and the lengths of inhibition of growth of the various micro-organisms were measured. The results revealed that *Butea monosperma* extract has antibacterial properties and tartrazine can be replaced with *Butea monosperma* extract, thus promoting the health of children.

5.5 Other applications

Other major industries where bio-colours occupy a place of importance is cosmetic industry as well as paper and pulp industry. Herbal cosmetics have growing demand in the world market and are an invaluable gift of nature. Aher *et al*. (2012) conducted a study to formulate herbal lipstick from *Bixa orellana* seeds, since lipsticks are one of the key cosmetics to be used by the women and the formulated herbal lipstick was found better and accepted by female volunteers.

Pulp dyeing is an industrial activity of great importance due to the extremely wide range of products made from dyed pulp, such as packaging materials, printing papers, household care and personal hygiene papers. They can also be used as an alternate source for synthetic ink. Saakshy *et al*. (2013) extracted dye from babool bark (*Acacia nilotica*) using different extraction methods for exploring its application in handmade paper industry and extraction of natural dyes from babool bark with solution of (methanol: water :: 1:1) showed better yield in comparison to extraction with water alone. Also it was found that the application of natural dyes enhances the credibility of handmade paper in global market.

A study was conducted to prepare edible ink in response to a survey in primary school where few children inadvertently ingested ink which may be harmful for their health. Powar *et al*. (2014) prepared four herbal inks from different biological sources such as *Beta vulgaris* (Beet Root), *Citrus limonene* (Citrus peel) *Pentas lanceolata* and *Bauhinia purpurea* (Butterfly tree). The prepared ink was filled in an ink pen and several characters like color, odour, taste, brightness, drying time, flow ability, non-clogging nature, viscosity, permanency of colour and stability were studied and evaluated. There was no visible change of colour of the ink in one week of exposure. All the inks were free flowing, non-clogging and with correct colour concentration. All the synthesized inks showed colour permanency for 1 week varying between 3-8days. All inks were found to be edible, safe and easy to prepare and stable (Table 4).

Table 4: Evaluation parameters of herbal ink from *Beta vulgaris*, *Citrus limonene*, *Pentas lanceolata* and *Bauhinia purpurea*

Parameter	***Beta vulgaris***	***Citrus limonene***	***Pentas lanceolata***	***Bauhinia purpurea***
Flowing ability	Free flowing	Free flowing	Free flowing	Free flowing
Clogging nature	Non-clogging	Non-clogging	Non-clogging	Non-clogging
Colour	Maroon	Yellowish	Red	Purple
Brightness	Dark	Light	Dark	Dark
Permanency of colour	3-8 days	3-8 days	3-8 days	3-8 days
Stability	Stable	Stable	Stable	Stable
Drying time	7-9 sec	7-10 sec	7-9 sec	7-15 sec

6. LIMITATIONS OF BIO-COLOUR

In spite of having several potential benefits, bio-colours have some limitations as well. Tedious extraction procedures of colouring component from the raw material, low colour value and longer time make the cost of dyeing with natural dyes considerably higher than synthetic dyes. Some of the natural dyes are fugitive and need a mordant for the enhancement of their fastness properties while some of the metallic mordents are hazardous. Nature is known to produce poisonous substances also; therefore thorough toxicological evaluations are necessary for the new sources of bio-colours.

Besides, there are problems like difficulty in the collection of plants, lack of standardization, lack of availability of precise technical knowledge of extracting and dyeing technique and species availability. The use of these colours in food products may also face some problems due to their instability during processing since they are sensitive to temperature, oxygen, light and pH. They may also be decolourised or degraded during storage. Anthocyanin degradation and brown pigment formation cause colour loss in food products.

7. CONCLUSION

The global trend towards the use of natural products in daily life and awareness for the ecosystem opens new avenues for the increased use of natural dyes and colours as they are eco-friendly, with no chemical reaction in their preparation, non-toxic and safe with no side-effects. Hence there is urgent need for proper collection, documentation, assessment and characterization of colour-yielding plants, supported by research activities to overcome the limitations of natural colours.

8. DISCUSSION

1. What are the enzymatic action involved in indigo extraction?

During fermentation, enzyme indimulsin, which is present in leaves convert indoxyl into indigotin which is responsible for the blue colour.

2. Which among the extraction methods is considered best?

Microwave extraction method is most efficient among all the methods.

3. How long the colour of the natural dyes on fabrics last?

Like any other colour, natural colour also fades away. It has poor lastness property when compared to artificial colour. It can be improved by proper mordanting and dyeing procedures.

4. What do you mean by super critical fluid?

A gas functions as a supercritical fluid above its critical values of temperature and pressure. For carbon dioxide, critical temperature is 31^0 C and critical pressure is 74 bar.

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10. ABSTRACT

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FLA 591: Master's Seminar

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Admission No: 2018-12-031	Date : 31-10-2019
Major Advisor: Dr. A. Sobhana	Time : 10 am

Bio-colours from ornamentals

Abstract

Our world is awash with colours. Colours are well-known since ancient time for their application in food, textiles, medicines, cosmetics and leather industries. In earlier days colours were derived from natural sources which were later replaced by synthetic colours. Due to the various detrimental effects of synthetic colours on human health and environment, there is an increasing trend towards their replacement with bio-colours.

Bio-colour is any chemical substance obtained either from plants, animals or natural minerals that is capable of colouring food, drugs, cosmetics or any part of the human body. Bio-colours are prepared from renewable sources and majority are of plant origin. Horticultural crops are considered as rich source of pigments and are commercially exploited worldwide for extraction of colours. Flower crops are one of the potential sources of pigments among horticultural crops.

Different methods are employed for the extraction of colouring materials which include aqueous extraction, alkali or acid extraction, microwave and ultrasonic assisted extraction, fermentation, enzymatic extraction, solvent extraction and super critical fluid extraction. Sharief (2013) extracted carotenoid and anthocyanin from four ornamental plants *Caesalpinia pulcherrima, Cassia fistula, Clerodendrum paniculatum* and *Delonix regia* using solvent extraction after fermentation and pre-treatment with NaOH. Maximum pigment yield was found in solvent extraction after fermentation. Highest carotenoid was observed in *Cassia fistula* and highest anthocyanin yield was in *Clerodendrum paniculatum*.

Colour is an important characteristic of food which makes it more attractive and appetizing. Annatto extract from *Bixa orellana* and carotenoid extract from *Tagetes erecta* are

widely used as food colours from ornamentals. Natural dyes from plants are also becoming more popular in textile and leather industries. A number of dyes are obtained from plants giving a wide range of shades with or without the use of mordants. Different parts of *Delonix regia* flower *viz*., whole flower, petal, calyx etc. can be exploited as a good sources of natural dye for silk dyeing with colours ranging from olive green to brown depending upon the choice of mordant (Purohit *et al*., 2007). Extracts of *Celosia cristata, Lantana camara, Rosa damascena* and *Tagetes erecta* were found suitable for colouring goat leather (Pervaiz *et al*., 2016).

Bio-colours also find their application in pharmaceutical industry, cosmetic industry as well as paper and pulp industry. *Butea monosperma* flower extract was found to be used as colouring agent for paediatric syrups (Bhadkariya *et al*., 2012). Herbal inks prepared from *Beta vulgaris, Citrus limonene, Pentas lanceolata* and *Bauhinia variegata* were found to be safe, easy to prepare and stable (Powar *et al*., 2014).

The global trend towards the use of natural products in daily life and awareness for the ecosystem opens new avenues for the increased use of natural dyes and colours as they are eco-friendly, with no chemical reaction in their preparation, non-toxic and safe with no side-effects. Hence there is urgent need for proper collection, documentation, assessment and characterization of colour-yielding plants, supported by research activities to overcome the limitations of natural colours.

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