Natural Ingredients for Colouring Hair

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Abstract

This paper examines some of the existing methods for colouring the hair and skin using natural material (such as henna) and proposes a parallel technology that exists in the dyeing of wool and fabrics to extend the colour range. Many of the listed plants and their derivatives are not found in Annex IV of the Cosmetic Directive and may not be used as colours, however, they do have other properties which may justify their inclusion into a product for example as astringent or anti-inflammatory agents. The references and appendices have been excluded from this abstract.

Introduction

The dyeing of hair has been practiced since the time of earliest Man. When it was impractical to dye the hair, then the wearing of wigs was customary, even as early as the period of the ancient Egyptians.

The use of natural dyes on the hair has not made very great progress, and this is due to a number of factors that should not be the reason for despair.

1. Natural dyes are not very stable in solution, are prone to oxidation, browning, discolouration, pH colour shift, fading and attack by UV light. However, none of these adverse effects are applicable to the dry powdered natural dye.
2. A single natural dye is not the right colour, and only henna or walnut seem to be suitable to colour the hair, perhaps with chamomile to tint blond hair.

The answer appears to be quite simple and one should blend different natural dyes in order to create a new colour that would be suitable as a hair colourant.

Consistency of supply

One of the major problems is the functional part of the herb (i.e. the colouring dyestuff). The chemistry is not always known by the formulator and therefore the concept of a natural dye is rejected. In reality, many of the dyestuffs in natural materials are identified and can be quantified or standardised in the specification for the raw material. Some of these active dyestuffs are given in Appendix I. Notice that many of them have C.I. numbers (Colour Index) as well as food "E" numbers as shown in Appendix II. This list is far from exhaustive.

Chemistry of Natural Dyes

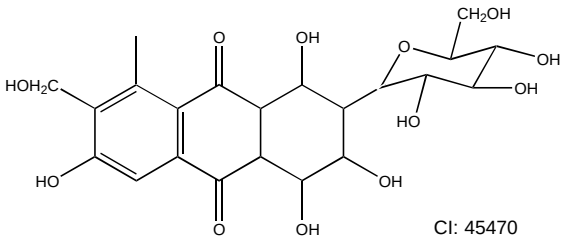
Carminic acid

This extract is associated with the protein material of the cochineal beetle and gives red, yellow and orange colours depending on the products and pH. *Coccus cacti* or scale insects are insects that live and feed on the prickly pear cactus (*Opuntia megacantha*) of Mexico and Central America. They increase rapidly in size and lose their original shape until they appear as protuberances of the plant. The dried pulverised bodies of these insects yield the red dyestuff cochineal, which the Aztec Indians used as a body paint and for dyeing their fabrics a brilliant crimson. They also used cochineal for medicinal purposes.

It has been used as a pigment and as a colouring agent in cosmetics, paints and beverages, but it is expensive as it takes 70,000 insects to make one pound of dye.

The homoeopathic tincture is prepared from the dried bodies of the female insects, which are larger than the male and have no wings. It is one of the main whooping cough remedies.

In both India and Australia attempts have been made to take advantage of this for the production of cochineal, for purposes such as dyeing soldiers' uniforms red. But chaos resulted. Either the insects fed so heartily that they wiped out the cacti; or the cacti multiplied so excessively that they became a real plague.



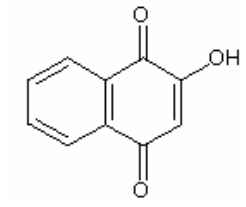
CI: 45470
Carminic acid

This can be purified to yield carminic acid or reacted with alumina to produce the aluminium lake of carminic acid which is referred to as carmine.

Carminic acid is a polyhydroxyanthraquinone acid. It is water soluble, acid stable yielding orange to red shades depending on the pH. Its aluminium lake, carmine, is soluble in alkaline media and is very stable to heat, light and oxygen. In alkaline conditions carmine provides a blue-red shade which becomes progressively less blue as the pH is decreased. Under acidic conditions below pH 3 carmine becomes insoluble.

Lawsone

A colour used frequently in hair care is from Henna or *Lawsonia alba*, *Lawsonia spinosa* and *Lawsonia inermis* and is present in the leaves. It is the chemical lawsone that is responsible for the red colour and is also found in *Juglans regia* or walnut. This colour has been used for nearly five thousand years and was used by the ancient Egyptians for dying their hair and nails. Henna or Egyptian Privet was not only used by the Queens of Egypt to dye their hair, but was also used to decorate their skin as well. Mohammed is said to have dyed his beard with henna.



It is reported that "*Lawsonia alba* is a shrub so laden with heavily scented white and yellow flowers that its perfume can be smelt a long way off. Every part of the tree is used by Eastern women to increase or restore their beauty. The powdered leaves make the best hair dye that is known and give the auburn colour that is so admired. Sudanese women make a paste with catechu, cover their heads with it and leave it overnight". The Malays are said to have a special Henna dance at weddings and use the leaves medicinally, externally to relieve tired feet. The plant has alterative, astringent and sedative properties.

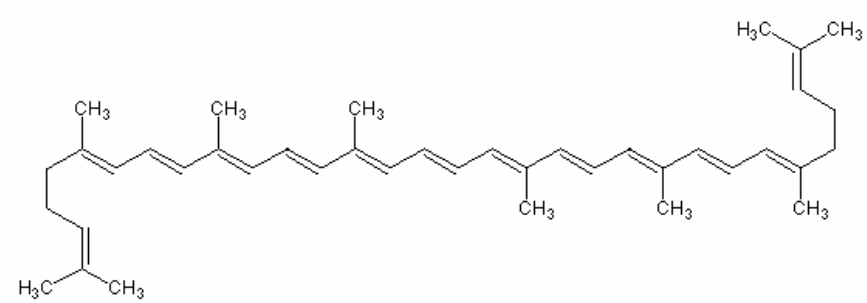
It is reported that henna is also used as a hair brightening rinse for certain shades of hair (particularly in those cases in which it is desired to bring up a chestnut or auburn tint). Its content of lawsone makes it a substantive dye for keratin in acid solutions, where the dye is formed within the hair and not as a coating as in the case of metallic dyestuffs. Henna is quite innocuous and very few cases of allergy have been reported in its use. To all intents and purposes danger from pure unadulterated henna is non-existent.

It has been reported that UV absorption properties can depend on the fact that chemical components are capable of reacting with the skin and so have UV absorption properties. In this respect, these 'interactive extracts' are similar in function to DHA or dihydroxyacetone. The best known in the category is henna, although walnut extract has also been used successfully. There are water and oil soluble versions available. This extract is made from the fresh green shells of English walnut *Juglans regia*. The aqueous extract has been shown to be particularly effective as a self-tanning sunscreen agent. Its most important component is juglone (5-hydroxy-1,4-naphthaquinone) a naphthone closely related to lawsone (2-hydroxy-1,4-naphthaquinone). The self-tanning properties of henna are a result of the interaction between lawsone and the skin. Likewise, juglone is known to react with the keratin proteins present in the skin to form sclerojuglonic compounds. These are coloured and have UV protection properties. It is likely that these reactions, as with DHA, are the result of Maillard and Browning reaction sequences. Unlike with DHA, the sclerojuglonic compounds have more of a red-brown colour, rather than the yellow colour associated with a keratin protein/DHA reaction.

Henna has also been used as a medication for scurf and superficial wounds,
and has been used to treat skin infections such as tinea and lawsone is also known to be antibacterial.

<u>Lycopene</u>

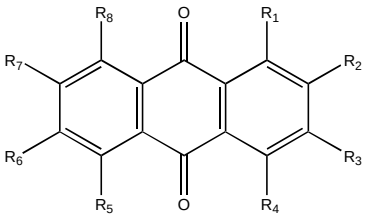
An extract from tomatoes that gives a red to orange colour and is also reported in other plant sources such as *Rosa rubiginosa* (rose hip), *Taxus baccata* (yew), *Calendula officinalis* (Marigold) and *Citrullus lanatus* (watermelon), though clearly at much lower levels. It has a similar structure to the other carotenes. It is a powerful antioxidant and



free radical scavenger.

Madder

Madder is native to the Mediterranean and the Near East and was once widely grown as a dye plant. The common name madder comes from the Anglo-Saxon name *maedere* for the plant. The generic name, *Rubia* means red and the plant has been used as a source of a permanent red dye.



ANTHRAQUINOIDS

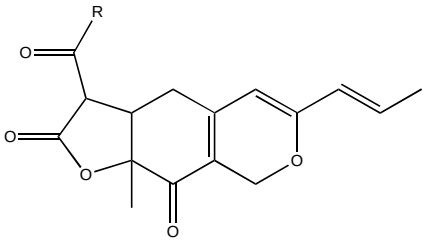
The two to three year old rootstock of the plants is used medicinally, which remains red when dried. The constituents include anthraquinone glycosides which are two red chemical entities derived from the roots and tubers, which are known as alizarin and purpurin.

	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	
Alizarin		OH	PH	H	H	H	H	H	H
Purpurin	OH	OH	H	OH	H	H	H	H	

It the care of the skin it is considered an astringent, tonic, vulnerary and antiseptic. Madder is also used to cleanse open wounds and can remove skin blemishes by applying the bruised leaves externally. Externally, a decoction of madder can be used for skin problems, especially tubercular conditions of the skin and mucous tissue. The decoction can also be used as a bath additive.

Monascus derivatives

The use of *Monascus* microorganisms is also a rich source of natural colour and produces chemical species that give a red colour. These include monascin, ankaflavin, rubropunctatin and monascorubrin, which have the following molecular skeleton. This is traditionally grown on rice in the Orient and is said to have an antibacterial effect. The colour is currently available in purple and in red, but a new yellow orange is close to being finalised commercially.



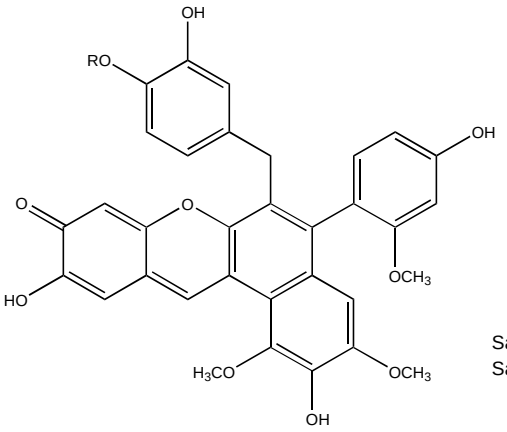
Since 800 AD, red yeast rice has been employed by the Chinese as both a food and a medicinal agent. The therapeutic benefits as both a promoter of blood circulation and a digestive stimulant were first noted in the traditional Chinese Pharmacopoeia, *Ben Cao Gang Mu-Dan Shi Bu Yi,* during the Ming Dynasty (1368–1644). Chinese traditional medicine practitioners utilize red yeast rice to treat abdominal pain due to stagnant blood and dysentery, as well as external and internal trauma. It is known as Hung-chu or Hong-Qu in Chinese.

Results suggest that pigments from *Monascus purpureus* could be an acceptable substitute for traditional colorants (tests performed in strawberry yoghurt!). While the

colour does change slightly during various production stages, the change is comparable to that of FD&C Red#40 and is less than the changes found using carmine or beet juice powder.

Santalin

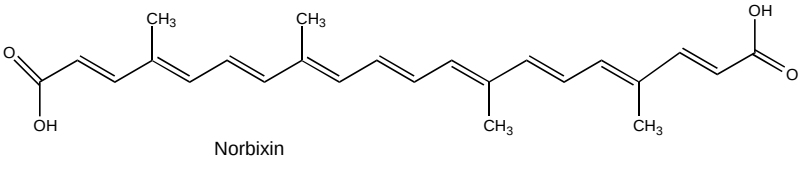
The red obtained from *Pterocarpus santalinum* or red sandalwood is a complex molecule known as santalin. There are a number of forms of this basic structure, which all give quite intense red colours. The stability of this red is quite good compared to the others. It has been traditionally used for many centuries. The red pigments are called santalin A (9,10,12-tri-o-methylsantalin) and B (9,10,12,4'-tetra-o-methylsantalin), while the yellow pigments are santalin Y and AC. The properties are said to be astringent, cooling and tonic, with possible benefits as an anti-inflammatory, anti-allergic, and for skin diseases (traditional use).



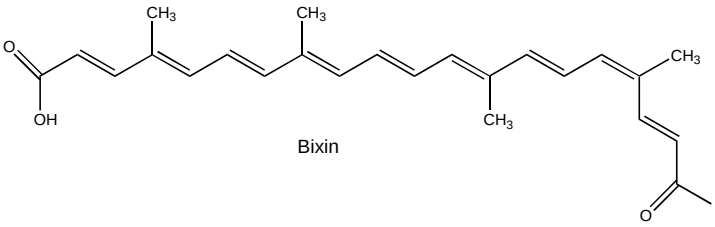
Santalin A R = H
Santalin B R = CH_3

Annatto

Annatto or norbixin is extracted from the *Bixa orellana* or lipstick tree; it gives a yellow to deep orange colour. . The plant has entered into commercial cultivation for the production of this dye which is used mainly in the food-industry and for colouring dairy products such as butter and cheese, margarine, edible oils, etc. It has been reported that the dye is also used in Brazil in pottery and as an insect-repellent, and in the Philippines in Boor, furniture and shoe-polishes, nail-varnish, brass lacquer, hair-oil, etc. It is further stated that Jamaica and S. India have been major producers of the top quality product. From other countries the dye has lacked the bright colour required. In South America the shrub is cultivated around villages, where it is native to and widespread throughout the neotropics. It is called *kiswe* or *kyswi* by the Waimiri Atroari. A red dye is obtained from the aril of the seed that is sometimes used for body painting. It is called *urucum* in the local vernacular.



Norbixin



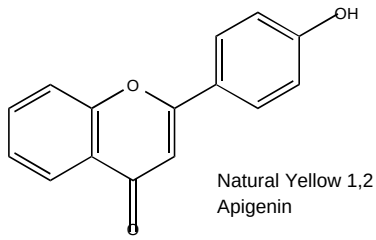
Bixin

Another chemical found in the plant that is responsible for some of the colour is bixin. Bixin is one of the more stable natural yellow colours. However, it loses much of its tinctorial power gradually on storage, the process being accelerated by light and heat.

Hence for manufacturing purposes fresh seeds are preferred. The tinctorial strength of bixin is comparable to that of ß-carotene, however, bixin is the more stable.

Apigenin

This flavonoid, which occurs widely in plants gives a dull, golden yellow and is usually obtained from German Chamomile or *Matricaria recutita.* Apigenin and lutolin were more active than the other flavonoids tested. The spasomolytic activity of chamomile has been attributed to apigenin, apingenin-7-0-glucoside and (-) - bisabolol, which have activity similar to papaverine and that Apigenin and lutolin were more active than the other flavonoids tested.



Natural Yellow 1,2
Apigenin

It is also found in Marigold (*Calendula officinalis*), where it was shown using the mouse ear test that the flavonoids - and not the essential oil - were responsible for the activity and, of these, apigenin was more active than indomethacin in the test.

Artemisia (*Artemisia inculta*) also contains apigenin and in a recent study was demonstrated to have anti-inflammatory activity.

Cuminum cyminum or cumin also contains apigenin and luteolin and their derivatives in addition to plants like Carrot (*Daucus carota*), Agrimony (*Agrimonia eupatoria*), Arnica (*Arnica montana*), Purple Coneflower (*Echinacea purpurea*) and Eyebright (*Euphrasia officinalis*) – all of which have demonstrated anti-inflammatory activity when used under the right conditions.

Canthaxanthin

This is a carotenoid that naturally occurs in fungi but is more usually produced by "nature identical" synthesis. It is also a component of Spirulina-Dunaliella algae. The colour can be yellow to an almost orange red.

Capsanthin and Capsorubin

Capsanthin and the related capsorubin are most commonly found in paprika or *Capsicum annuum.* It is rich in carotenoid pigments, including capsanthin, capsorubrin, carotene, luteine, zeaxanthin, and cucurbitaxanthin.

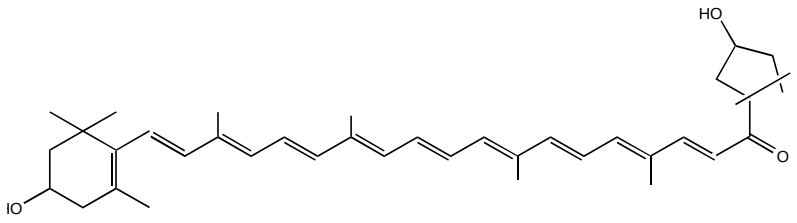


Fig. Capsanthin

As well as being a dyestuff, it is also used in cosmetics in ointments, oils and emulsions for its stimulating effect and as a sports massage.

It is also called Capsicuym, Cayenne pepper, African Pepper, Chillies, Bird Pepper. It contains 0.1% capsaicin, capsacutin, capsico (a volatile alkaloid?) together with fixed

oils. Capsicum in the form of an alcoholic tincture is sometimes incorporated into hair lotions as a stimulant, particularly in preparations designed for alopecia.

It is employed in preparations to prevent chilblains and is the purest and most certain stimulant in *materia medica*. It produces natural warmth and equalises the circulation. It is an important herbal remedy. It is used externally as a counter-irritant, rubefacient and antiseptic. It is recommended for use in neuralgia, rheumatic pains, unbroken chilblains and is also used in cases of lumbago.

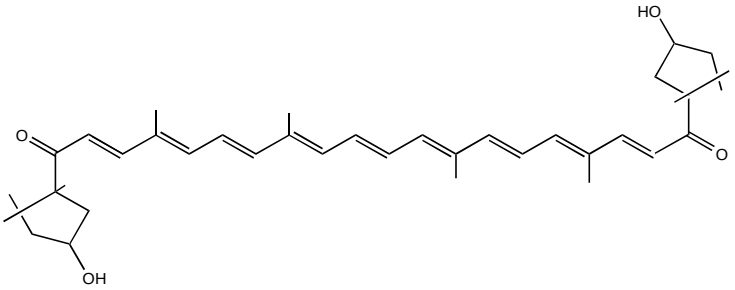
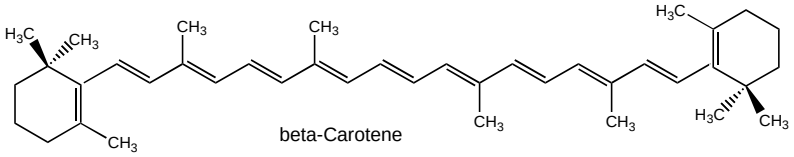


Fig: Capsorubin

Capsicum is especially useful for providing counter-irritation when applied to skin overlying an inflamed or irritated joint. Combined with myrrh it makes a good antiseptic wash.

Carotenes

This is a group of yellow/orange colours extracted from such diverse sources as algae, carrots and palm oil. It is also available as a "nature identical" product.



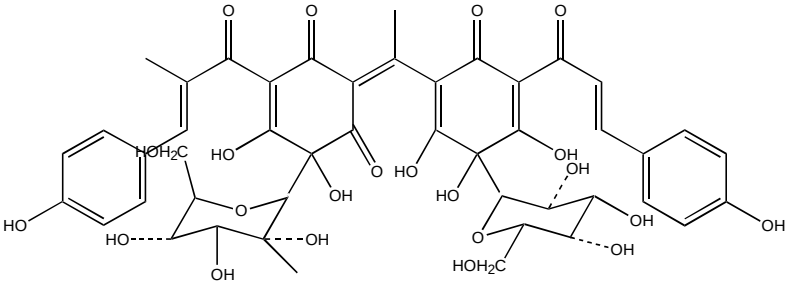
The carotenoids - apart from the chlorophylls - are the largest group of oil soluble pigments found in nature. They consist of molecules with long chains made up of carbon, hydrogen and mostly oxygen (ß-carotene consists of only carbon and hydrogen). One of the carotenoid's characteristics is that the colour varies (according to the type of carotenoid) from yellow to red-orange. Carotenoids, like chlorophylls, exist in green plants. They are responsible for the yellow colour of flowers and the pigments of many fruits and vegetables like carrots, paprika and tomato. The first discovery of the colour in carrots was the reason for the generic name of carotenoids. It is converted by mammals into vitamin A and as a result is called provitamin A.

ß-carotene is one of the major yellow colours used in the food industry and the largest use is by the dairy industry (butter, cheese and ice cream). The use of ß-carotene has almost entirely replaced E102 Tartrazine yellow, which for various reasons has received bad press in recent years.

ß-carotene is one of the popular free radical scavengers and antioxidants.

Carthamin

It is found in the flowers of *Carthamus tinctoria* or Safflor (Bastard Saffron), Dyer's Saffron, American Saffron, Fake Saffron,

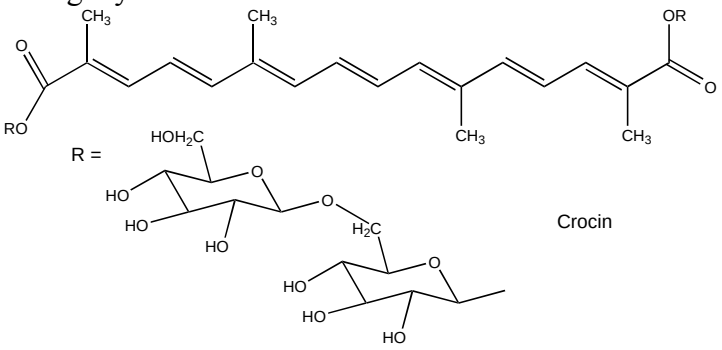


or *Flores Carthami*. It yields a pigment carthamin, which is a yellow-orange colour. On closer examination it is shown to contain two colouring matters, one yellow the other red. The seeds yield an oil, which is used in India for burning and for culinary use. The flowers are used for their laxative and diaphoretic properties, also used in children's complaints of measles, fevers and eruptive skin complaints.

Apart from the seeds for oil and the flowers for dyeing, the Egyptians found the flower pleasing to the eye and included it in garlands laid on the mummies of their relatives. Remains of safflower were found in the tomb of Tutankhamun.

The safflower florets are gathered just before they die off, and are used for dyeing wool, silk and leather. The flowers give a yellow dye, and the Chinese used an alkaline solution to produce the bright reds and purples for their silks. It also produces a pink dye that was used by the Indians to dye their official red tape used on legal documents. Mixed with talc it was employed as rouge by actors. It was also the principal ingredient in Macassar Oil, the hair oil so very popular with the Victorian gentlemen.
Certain oil paints are based on carthamin.

Crocin



Crocin

A bright yellow colour that has been in use for over a thousand years. Extracted from the fruit of *Gardenia jasminoides*. *Gardenia florida* [possibly a synonym for *G. jasminoides*] also contains crocin and is prescribed as antipyretic, haemostatic, antiphlogistic and in jaundice. A paste of the herb with flour and wine is used as a poultice on twists, sprains, strains, bruises, and abscesses; very effective in injuries to tendons, ligaments, joints and muscles. Chinese medicine considers it to have anti-inflammatory, antipyretic, astringent, and haemostatic functions as well as use in the treatment of mastitis. The main component of its yellow pigment is crocin, which is now generally used as a natural yellow pigment. It is also used for irritation, sore and swollen eyes and abscesses. *Fructus gardeeniae* is widely used in Chinese medicine. The fruits of *Gardenia jasminoides* also contain ursolic acid which possesses hypothermic, sedative and anticonvulsant activities. The activity of this plant may, therefore, be in part due to the ursolic acid present.

Crocin is 8,8'-Diapo-ψ,ψ-carotenedioic acid bis (6-O-ß-D-glucopyranosyl-ß-D-glucopyranosyl) ester; α-crocin; di-gentiobiose ester of crocetin. It is also the colouring principle of saffron and also occurs in crocus.

Crocetin

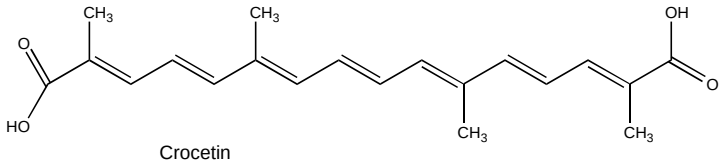
It is also known CI Natural Yellow 6; Colour Index 75100; Croci Stigma; Crocus; Safran. The dried stigmas and tops of the styles of the *Crocus sativus* contain crocines, crocetins and picrocrocine. They are delicate colours and should be protected from light.

Saffron is used as a food and cosmetic dye and flavouring agent. In some circles it is considered to be a food. It was once widely used for colouring medicines. There have been early reports of poisoning with saffron. This may be because of confusion with Autumn Crocus (*Colchicum autumnale*).

For years English saffron was the most highly esteemed (grown in Saffron Walden from about 1350), and most expensive, in Europe. Today, however, the best saffron comes from the barren plain of La Mancha in Spain. One kilogramme of plant yields about 460,000 stigmas. The colour is due to a pigment called crocin, so strong that 1 part crocin in a 100,000 parts of water is a deep golden colour. The flavour comes from a related compound called picrocrocin. Saffron also seems to contain a substance that helps blood to clot. It is as a water-soluble dye that saffron probably found most use. The colour is deep and rich, and most familiar today in the saffron robes of Buddhist monks.

Folkloric uses of saffron have included its use as a sedative, expectorant, aphrodisiac and diaphoretic. Anecdotal reports from the tropical regions of Asia describe the use of a paste composed of sandalwood and saffron as a soothing balm for dry skin.

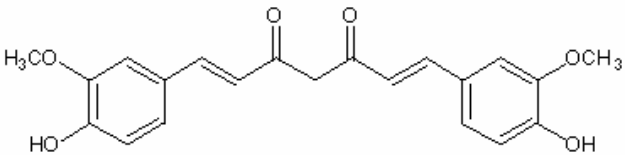
The stigmas of *Crocus sativus* are rich in riboflavin, a yellow pigment and vitamins. In addition, saffron contains crocin, the major source of yellow-red pigment. An hypothetical protocrocin of the fresh plant is decomposed on drying into one molecule of crocin (a coloured glycoside) and two molecules of picrocrocin (a colourless bitter glycoside). Crocin is a mixture of glycosides: crocetin, a dicarboxylic terpene lipid, and alpha-crocin, a digentiobiose ester of crocetin. In addition, cis- and trans-crocetin dimethylesters have been identified. Similar compounds have been isolated from other members of the family. A compound named gardenidin, obtained from gardenias, has been shown to be identical with crocetin.



Crocetin

Curcumin

This is the pigment of the spice turmeric and will give a range of colour from yellow to a deep orange. This has been in use as a food ingredient for over 2,000 years. It also contains a closely related chemical called desmethoxycurcumin, where one of the methoxy groups is replaced with a hydrogen atom.



The rhizome of *Curcuma longa* has been used as a medicine, spice and colouring agent for thousands of years. Turmeric was listed in an Assyrian herbal dating from about 600 BC and was also mentioned by Dioscorides. Amongst its many medicinal properties are as its use as an antioxidant and anti-inflammatory. The anti-inflammatory activity of curcumin was first reported in 1971. In an extension of this work, it was reported that oral doses of curcumin possess significant anti-inflammatory action in both acute and chronic animal models. Curcumin

was as potent as cortisone in the acute test (carrageenan oedema), but only about half as potent as phenylbutazone in chronic tests.

The Negritoes of the Philippines utilise the fresh rhizome to treat recent wounds, bumps, bruises and leech bites. Mixed with gingelly oil (a localy produced oil), it is applied to the body to prevent further skin eruptions. Turmeric paste mixed with a little lime and saltpeter and applied hot is a popular application to sprains and bruises among other Filipino blacks. In smallpox and chickenpox, the Negritoes make a thin paste of turmeric powder and apply it to the entire body in order to prevent pock marks from occurring by facilitating the scabbing process. It is also used for ringworm.

The blacks of Trinidad in the West Indies use turmeric rhizome poultices to reduce the swellings of sprains and pulled tendons, while the rhizome juice and oil is used for its antiseptic properties on various skin affections - i.e. razor bumps, herpes lesions and venereal sores.

Among the dark races of India, turmeric has been used since time immemorial to treat skin problems. Both the Ayurvedic and the Unani practitioners have used a paste of powdered turmeric or its fresh juice made into a paste or a decoction of the whole plant as a local application in the treatment of leprosy and cobra bites. It is especially useful for indolent ulcers on the surface of the skin and gangrene in the flesh. A paste made from the powdered rhizomes along with caustic lime forms a soothing remedy for inflamed joints.

Turmeric is also as an external application of "rouge" and is used by some women in India to suppress the unwelcome growth of facial hairs and upper lip moustaches.

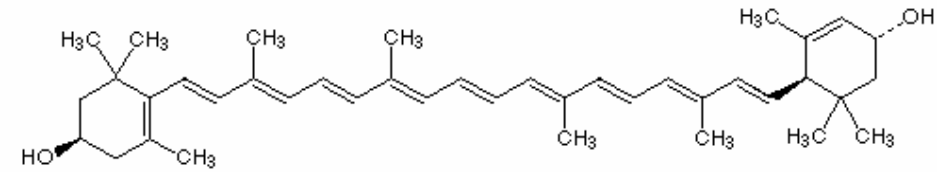
In Northern India the rhizome is used by many natives for treating cuts, burns and scalds.

The natives of Samoa use the powdered rhizome to sprinkle on newborn infants to help heal a recently cut umbilical cord, to prevent nappy rash from occurring, and to keep the skin continually soft and resilient. The powder is also used as a paste or poultice to treat skin ulcers and to help heal extensive skin eruptions.

In parts of Africa, turmeric has been successfully tested for healing rashes due to allergies and psoriasis inflammation and itching accompanying arthritis.

Lutein

An extract from *Tagetes erecta* (the Aztec Marigold). This is a xanthophyll which occurs naturally in all green leaves, green vegetables, eggs and some flowers. Exhibits egg to lemon yellow colours.

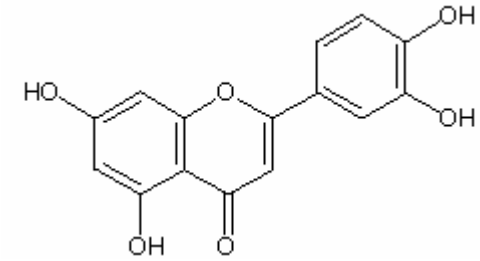


Lutein is found in plants like dandelion (*Taraxacum officinalis*) along with violaxanthin, St. John's Wort (*Hypericum perforatum*). Marigold (*Calendula officinalis*) and Orange

peel (*Citrus aurantium amara*). Interestingly, lutein is often found in combination with violaxanthin.

Luteolin

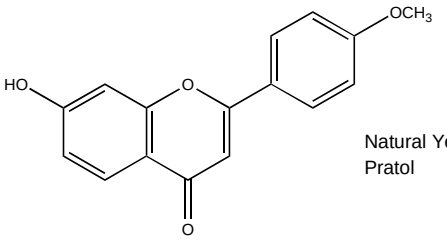
The colour luteolin is found in Dyer's Rocket (also known as Weld) or *Reseda luteola*. It is one of the oldest yellow dye plants and is found in many parts of Central Europe. The leaves and seeds are used, which contain more dye than the stems. An infusion of the plant has been used for treating wounds.



This dye is also present in Dyer's Broom, Dyer's Greenweed or *Genista tinctoria*, where the colour is a more green-yellow. An infusion of the plant has been used for chronic skin disorders. It has anti-inflammatory and antibacterial properties. The 7-glucoside and 7-glucuronide is found in the petals of *Antirrhinum majus* (Scrophulariaceae). The 7-galactoside and 7-rutinoside occur in *Capsella bursa-pastoris* (Cruciferae) and the 3'-glucoside in *Dracocephalum thymiflorum* (Labiatae).

Pratol

From clover or *Trifolium pratense* one can obtain a natural colourant called pratol (7-hydroxy-4'-methoxyflavone) which is a dull, golden yellow. There are a number of flavonoids that can be used from plant sources. Clover has been traditionally used for eczematous skin conditions, especially where the skin is pruritic. It is also useful for boils and pimples. A lotion of red clover used externally can give relief from itching in skin disorders, acne, boils and similar eruptions, as well as eczema and skin problems with irritation.



Natural Yellow 10
Pratol

According to another source it is also found in Yellow Sweet Clover or Melilot (*Melilotus officinalis*), where flower heads are used externally in the treatment of ulcers, burns, sores and skin complaints. Used internally to treat chronic skin conditions such as psoriais and eczema.

Caramel

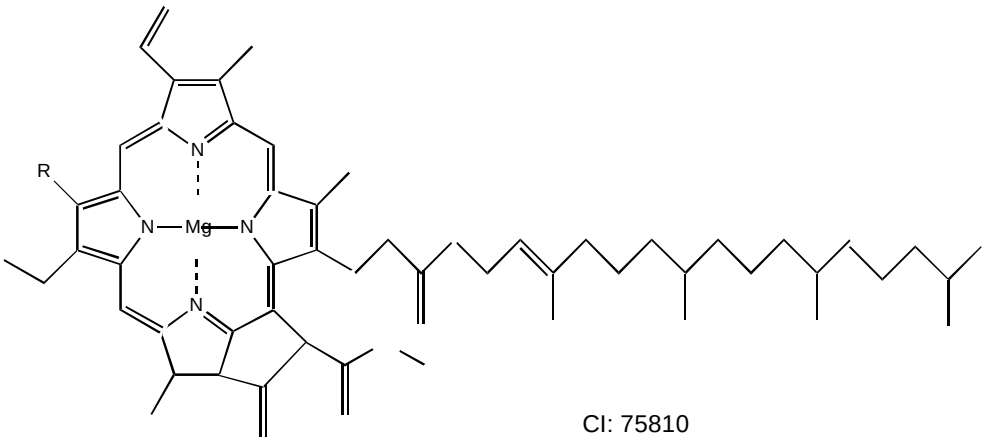
E150 caramel is produced by heating food grade carbohydrates in the presence of selected accelerators. Caramelised sugar or burnt sugar is formed by heating sugars without a catalyst.

Cocoa

Extracted from cocoa beans and used in both food and drink products.

Chlorophyll

Extracted from grass and alfalfa, this is present in all green plants and has always been a part of man's diet. Gives a moss green colour. Naturally oil soluble. It is also found in green vegetables such as spinach or *Spinacia oleracea* and the common stinging nettle or *Urtica dioica*.



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Chlorophyll

Copper chlorophyll

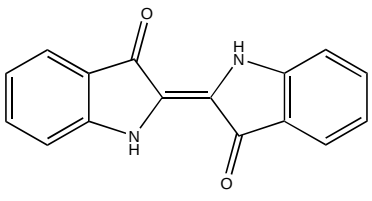
Derived from plants (as above) but gives a brighter more intense green colour due to the replacement of the naturally occurring magnesium in the chlorophyll by copper. It is naturally oil soluble.

Copper chlorophyllin

This is produced as the copper chlorophyll but a saponification process renders this form water soluble. The colour is a bright green to green/blue.

Indigo

Extracted from the fermented leaves of the plant *Indigofera* spp. This produces a blue to mauve colour called indigotin (an indigoid structure). *Indigofera tinctoria* was also known as Pigmentum indicum.



The blue dye is produced during the fermentation of the leaves, which is achieved using caustic soda or sodium hydrosulphite. A paste exudes from the fermenting plant material which is processed into cakes that are then finely ground. The blue colour develops as this powder is exposed to air.

Indigo dye is a derivative of indican, a glucoside component of numerous *Indigofera* species and this is converted to blue indigotin using an enzyme process. This dye is quite colourfast and is combined with stabilisers and other compounds to produce a wide range of colorants. Today, almost all indigo used commercially is produced synthetically.

It is said to be good for mouth ulcers and externally the ointment will help infected ulcers and sore nipples.

Colour blending

The blending of red with green will give brown shades, which can be gently modified with the addition of yellows, oranges and other browns.

Mordants and the hair

On many occasions it is not just a question of using a single dye on its own to achieve the colour.

- The pH is critical and the pre-treatment of the hair is vital, if you wish to achieve a variety of colours
- It may be necessary to blend different dyes
- Mordants might have to be used

There are two kinds of natural dyes: substantive and adjective. *Substantive* dyes (lichens and walnut hulls, for instance) need no mordants to help them adhere to the fibre, whereas *adjective* dyes do. The mordant joins with the fibre and the dye to set the colour permanently. It enters deeply into the fibre, and when the dye is added, they combine to form a colour; since the mordant is thoroughly embedded, so is the colour. This is the principle behind the process. Adjective dyestuffs are not able to penetrate the hair sufficiently to keep from washing or fading away, unless a mordant is used.

Mordants that may be considered

ALUM (potassium aluminum sulfate) is the most common mordant. If unsure of what you to do, then it is advised to mordant with alum, and use the others as additives. Alum does not affect colour. It is usually used with cream of tartar, which helps to provide evenness and will also brighten slightly.

IRON (ferrous sulfate) is called copperas. It will sadden or darken colours, bringing out green shades. Usually a fibre like wool is dyed *before* mordanting with iron.

TIN (stannous chloride) blooms or brightens colours, especially reds, oranges and yellows. Almost always used with cream of tartar. Tin is a good additive mordant.

BLUE VITRIOL (copper sulfate) saddens colours and brings out greens. It is a good additive.

TANNIC ACID is a good mordant if you want tans or browns. Fibres mordanted with tannic acid before dyeing tend to darken with age.

GLAUBER'S SALTS are used as a levelling agent are are not a mordant. Colour will change slightly. Other mordants such as vinegar can also be used. In this paper we have endeavoured to bring a concept, and researchers are strongly advised to look at

other possibilities for mordants and to assess what other colours may be achieved with different materials.

Conclusion

The purpose of the paper was not to give a series of answers, so much as to present a selection of ideas for colorants and new hair care concepts.