



ANCIENT SUNRISE®

Plants that Dye Hair



Catherine Cartwright-Jones PhD

Ancient Sunrise® Henna for Hair, Chapter 5, Plants that Dye Hair

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Cover Graphic by Alex Morgan

Published by TapDancing Lizard® LLC

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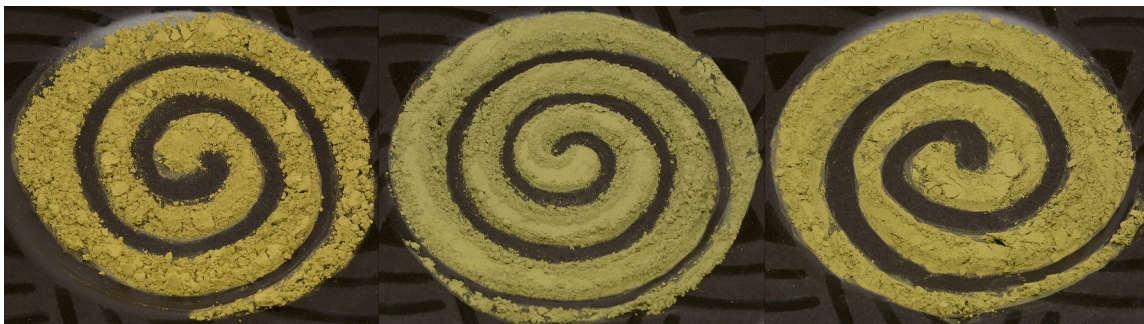
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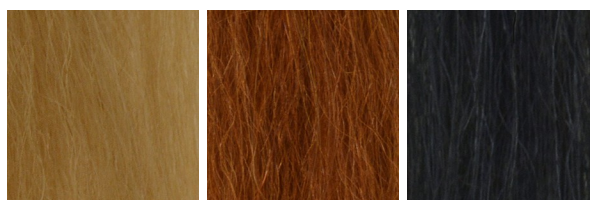
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Three Plants Dye Hair: Henna, Indigo, and Cassia



Powdered cassia, henna, and indigo leaves

Few plants can be used to dye hair conveniently and safely. Henna, indigo and cassia powders are green powders, similar in appearance, because they are all dried powdered leaves, and all contain dye molecules that can safely and effectively dye hair. The green chlorophyll in the leaves hides the dye molecules. Cassia contains a yellow dye molecule. Henna contains a red-orange dye molecule. A dark blue dye molecule can be derived from indigo. These dye molecules will stain keratin, the structural protein of hair.



Cassia, henna, and indigo stains on light-colored human hair

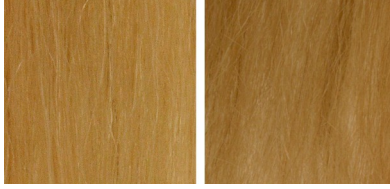
The shape of a hair keratin molecule has sites for dye molecule binding, and these sites have specific shapes and conditions for binding. Henna has lawsone, a naphthoquinone molecule, which binds very efficiently with keratin. Cassia has chrysophanic acid, an anthraquinone, which does not bind as efficiently as henna. Fermented indigo has a molecule, indigene, which can be broken down to an indoxyl that will bind to keratin, but this molecule is unstable.

One way or another, the pigment in the powdered cassia, henna, or indigo leaves has to migrate from the leaf to the hair, and then bind with the keratin in hair, rather like ‘tetriminos’ that you coax into place during a game of Tetris, or like a wet tea bag staining a white tablecloth.

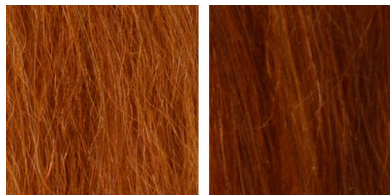
Only a few pigments will bind with hair and dye it permanently. Beet juice won’t dye hair red; it will wash out. Blueberries won’t dye hair blue. Beet juice and blueberries will color ice cream, but their dye molecules aren’t the right shape for ‘keratin tetris.’ Madder can temporarily stain hair rich red, but fades after a few washings. Wool and silk dyers often use heat and mordants to make differently shaped molecules attach to hair. Heat expands the keratin molecules, so it’s

easier to jam in a molecule that doesn't quite fit. Mordants 'rough up' a molecule so it's easier to jam in a dye molecule that doesn't really fit.¹

When these cassia, henna, and indigo molecules bind with keratin, they dye hair.²



Different fruit juices mixed with cassia will change the stain results. Cassia is translucent and the results will be different on different colors of hair. Cassia will not make hair a paler color.



Different fruit juices mixed with henna can change the stain results. Henna is translucent and the results will be different on different colors of hair.



You can achieve a broad range of colors by mixing cassia, henna, and indigo, and using different fruit juices in the mix.



You can dye hair 'black cat black' by dyeing it first with henna, then dyeing over that with indigo.

¹ Since it is imprudent to boil your head or soak it in a caustic solution, we're limited to the few molecules that bind easily to keratin.

² Painting hair is different from dyeing hair. Paint adheres to a surface (like a tee shirt with a rock band logo). A dye penetrates the surface and stains it (like a tie dye tee shirt).

Henna, *Lawsonia Inermis*



Henna, *lawsonia inermis*: new leaves after a summer rain.

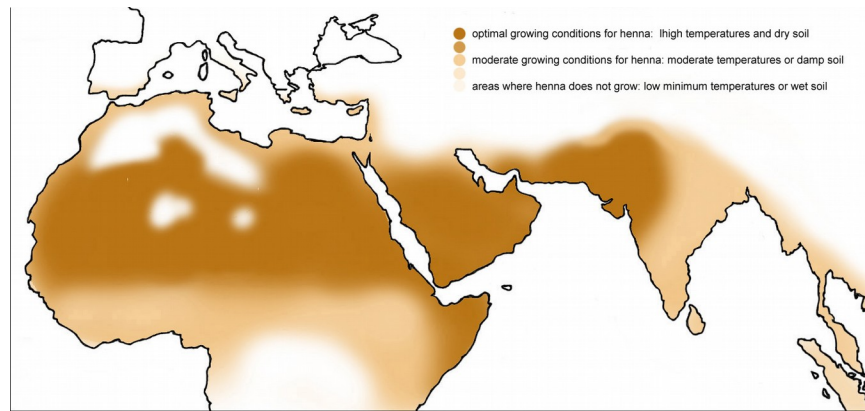
What is Henna?

Henna, *lawsonia inermis*, is a large bush or small tree native to hot, dry climates across North and East Africa, the Arabian Peninsula, the southern areas of the Middle East, and South Asia. Henna probably originated in North Africa, based on the greater genetic diversity in henna in the North African oases than in other regions.³ Humans probably first developed their use of henna during one of the ‘moist’ phases in the region of the Sahara; the most recent ‘greening’ was from nine thousand to about five thousand years ago.

There is archaeological evidence from Egypt that henna was regularly used to treat skin ailments and to color gray hair five thousand years ago. There is evidence that brides marked their hands and feet with henna for weddings in Mesopotamia and the eastern Mediterranean.

Henna will tolerate long droughts and high heat, but not moist soil or frost. Henna does not grow in any area where there is frost. Henna does not grow in rainforest climates. Muslim traders and settlers brought henna to western Australia, and it has naturalized there. Henna has never grown in the Americas other than as an imported decorative plant, though there are a few permanently warm and frost-free areas where it could be naturalized in Mexico and Argentina.

³ Boubaya, Anissa, Hédia Hannachi, Nidhal Marzougui, Tebra Triki, Ferdaws Guasmi, and Ali Ferchichi. 2013. "Genetic diversity assessment of *Lawsonia inermis* germplasm in Tunisian coastal oases by ISSR and RAPD markers." *Dendrobiology* 69, 31-39.



Map of henna growth range during present climate

In the 19th and early 20th centuries, most of the henna used by Europe and the USA was grown in Egypt. India is presently the largest exporter of henna. Indian governmental support of the henna industry has improved henna cultivation and technology, helping farmers to have a cash crop during years when other crops fail. The Indian government also supplies free henna plants to farmers in the arid western region to protect their soils from desert encroachment.



Henna, *lawsonia inermis*

Henna's leaves have a red-orange dye molecule, lawsone, visible in young leaves in the center vein of the leaf. The petiole, the center vein of the leaf, has the highest lawsone content.⁴ Henna branches grow quickly after rainy spells. The small branches are then pruned back and the leaves stripped away and allowed to dry. On commercial henna plantations, little trees are often pruned of their branches back to 3' tall; the branches will regrow quickly after the next rain. Henna may be pruned for leaf harvesting up to three times a year, and may live for fifty years. In western India where there are large fields of henna, the November harvest generally has the highest lawsone content, following the rapid growth from the monsoon rains.

⁴ The petiole is the center rib of a leaf. In Romaine lettuce, the petiole is the crunchy center part.



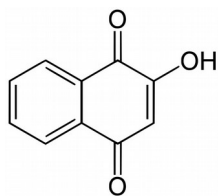
Henna, *lawsonia inermis*

The fully-grown leaves contain 0.3% to 4% lawsone content, depending on climate, weather, and soil conditions. Commercially available pure henna sold for body art typically has 1.7% to 2.4% lawsone after milling, packaging and export. The lower dye content leaves, 0.3% to 1.1% lawsone, roughly powdered and sifted, are sold to the hair dye industry.⁵ It is not true that the greenest leaves have the highest dye content, though brown leaves may be poor quality. Indian henna exporters often put green dye in their henna to make it appear to be better quality.⁶ Ancient Sunrise® henna does not contain green dye.

Henna leaves may be used fresh, though they are more often harvested, dried, and powdered. When pulverized henna leaves, fresh or dried, are mixed with a mildly acidic fruit juice, the lawsone molecules in the henna will be made available for dyeing. If you put henna paste on skin or hair, the lawsone molecules will migrate from the plant pulp, into keratin, leaving a red-orange stain. This action is similar to putting a wet teabag on a white tablecloth. The longer you leave the wet teabag on the tablecloth, the darker the stain. The longer you leave the henna paste on skin or hair, the more lawsone molecules will have the opportunity to migrate into the keratin, though six hours generally is enough for maximum absorption of henna. As more lawsone molecules migrate into keratin, the more saturated and rich the color.

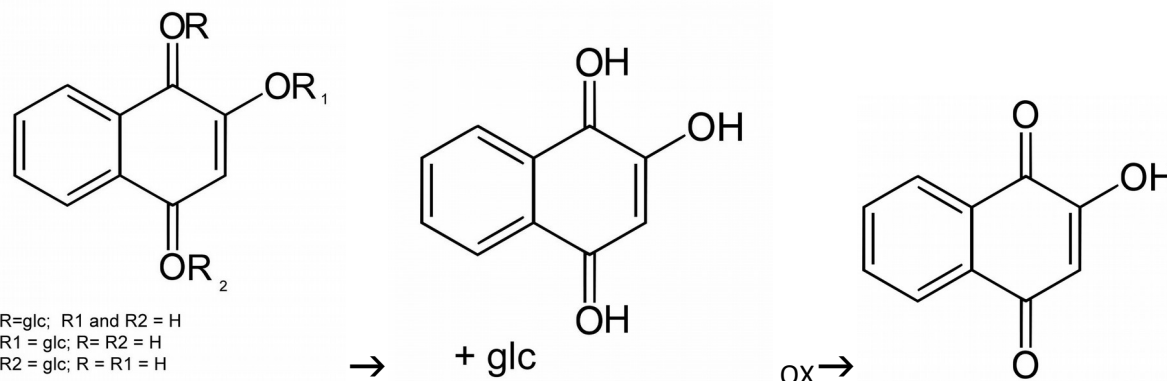
⁵ Between 2008 and 2014, the date of this writing, I have submitted several dozen samples of henna to an independent certified laboratory for HPLC lawsone testing. The results have ranged from 0.3% to 3.4% lawsone, all done by the same laboratory using the same methodology.

⁶ Chourasia, Sardar, Patil, and Mathew, Kanpur. "Study of Quality Characteristics of Henna." *Essential Oil Association of India*. India. 1989



Lawsone is the dominant dye molecule produced by henna.

An HPLC test of powdered henna leaves generally shows 0.5% to 3% lawsone, a red-orange naphthaquinone molecule⁷ which readily, harmlessly, binds with and stains keratin. This staining action is facilitated when the powdered henna leaf material is mixed with a mildly acidic medium; a pH 5.5 paste mix is ideal. At this mildly acidic pH, the lawsone molecule can be released from its position on the tannin and migrate from henna paste to stain keratin.⁸ A Michael Addition facilitates a non-fading stable bond of the lawsone molecule with keratin. This red-orange stain can gradually oxidize to a brownish color when bound with keratin. In alkaline conditions, the stain can oxidize to black or greenish black.



The sequence of henna dye release and binding is as follows:⁹

Lawsone is produced by hennocide precursors in the henna leaf.

The precursor is converted into the intermediate aglycone by hydrolysis in mildly acidic conditions. The aglycone intermediates will bind to keratin. Neither the precursor nor the final lawsone will bind as effectively to keratin as the aglycone intermediate.¹⁰ In the mildly acidic henna paste at room temperature, the aglycone will become available after about an 8 hour soak, and remain at maximum in the paste for 12 – 24 hour hours, after which the percentage of the

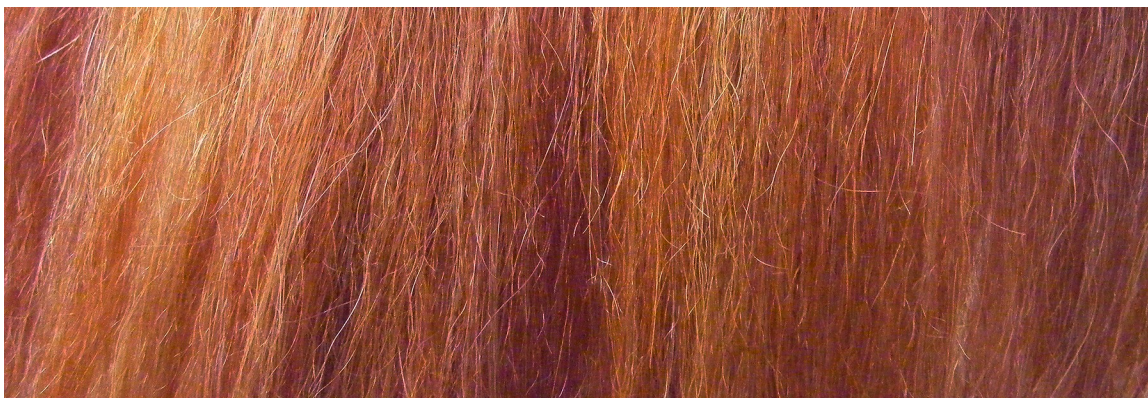
⁷ HPLC laboratory results, Alkemist Laboratories for TapDancing Lizard LLC, 2008 - 2016

⁸ Amro, I. H., James, K. C, and Turner, T. D.; 1993. "A Quantitative Study of Dyeing with Lawsone," *Journal of the Society of Cosmetic Chemistry*, **45**, 159 - 165

⁹ Gallo, F., Multari, G., Palazzino, G., Pagliuca, G., Zadeh, S. M. M., Biapa, P. C. N., Nicoletti, M.; 2014. "Henna through the Centuries: A quick HPTLC analysis proposal to check identity." *Revista Brasileira de Farma Cognisia*. **24**, 2

bindable aglycone form of the lawsone molecule will gradually diminish. This is termed ‘demise’ of the henna paste. At this point the henna paste produces diminishing stains. This transformation is gradual at room temperature. It proceeds more quickly in warm conditions and slows under cold conditions. Eventually all of the unstable aglycones will transform to the stable non-bindable form of keratin. This usually happens in about one week at room temperature; in henna work, this is referred to as demise. This demised henna paste stains keratin a weak orange color which will not darken because it can no longer bind through Michael Addition.

The acidic paste maintains the hydrogen atoms on the corners of the aglycone, the intermediate form of the lawsone molecule. In acidic mixes of henna, the intermediate form of lawsone will migrate into the keratin in hair or skin, and darken as it binds permanently with the keratin by a Michael Addition.¹¹ If the henna powder is mixed only with water, the hydrogen atoms are not as well conserved. Henna mixed with water is more likely to fade from hair because unbound lawsone will gradually wash out of hair. Henna mixed with a mildly acidic mix will leave a stain in hair that is not only permanent, but will gradually darken, and continue to darken for years.



Variations of color with different lawsone content hennas and different acidic mixes, on identical samples of light colored hair

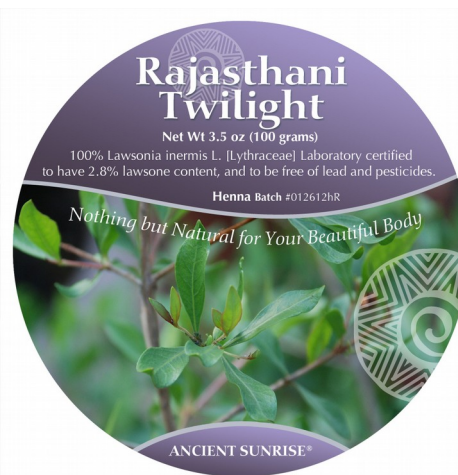
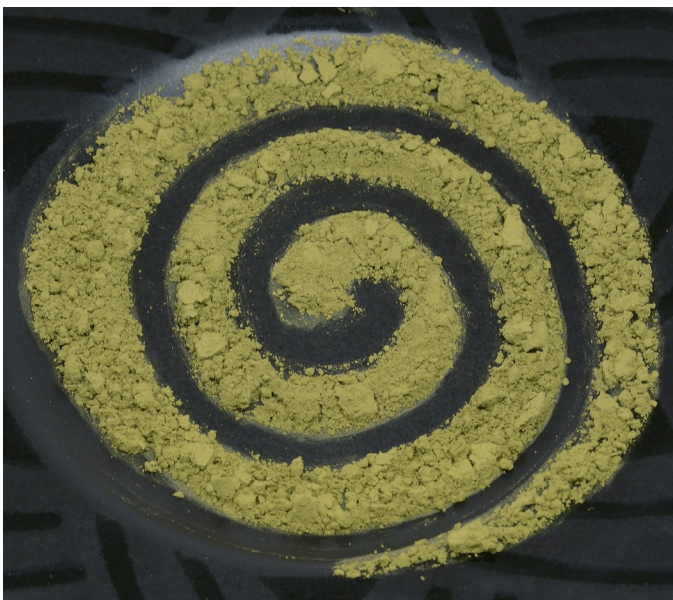
The lawsone in henna will dye hair some tone of red-orange, light coppery orange to dark auburn, depending on the base hair color, keratin structure, and the paste mixture. Every batch of henna has a slightly different level of lawsone because it is an agricultural crop. The genomes of cultivated henna plants are still close to the wild variants; the henna plant has not yet been modified, improved, and standardized. Weather and local soils affect the harvest. The harvesting, transport, storage, and milling processes have been improved over the last thirty years, producing a finer sift with water, air, and lightproof packaging, so the product stays fresh longer, but there is still a great deal of variation, even in one crop from one company.

¹⁰ Attempting to improve henna powder by adding lawsone powder will not improve the henna stain. Only the intermediate aglycone can effectively stain the hair.

¹¹ Ruchi Badoni Semwala, Deepak Kumar Semwala, Sandra Combrinck, Catherine Cartwright-Jones, Alvaro Viljoen "Lawsonia inermis L. (henna): Ethnobotanical, phytochemical and pharmacological aspects." *Journal of Ethnopharmacology*, June 2014

Ancient Sunrise® submits every batch of henna to an independent laboratory for an HPLC lawsone test, to monitor the variability. Every batch is unique. Higher levels of lawsone are more effective for covering gray hair, mature to a browner tone. We recommend henna with higher lawsone levels those for dark-haired people who want to cover their gray hair. Lower levels of lawsone tend to stain hair lighter, brighter reds.

Henna powder smells a bit like a bale of hay. The earthy henna scent lingers in hair and on skin. People perceive the scent differently; some people love it, and some dislike it. If you dislike the scent of henna, mix ginger powder into the henna paste to reduce the odor. Cardamom powder can also mask the odor of henna. In any case, the henna scent will go away after a few shampoos.



Ancient Sunrise® Henna Powder

Pure henna, 100% lawsonia inermis, can condition and strengthen hair. The lawsone molecule, when bound into keratin, is a complete sunblock, protecting hair from UV damage. Pure henna preserves moisture in hair by making it less prone to weathering and desiccation. Hennaed hair can appear to grow faster because the ends are no longer drying and breaking off.

Pure henna, 100% lawsonia inermis, has a very high level of safety. Most sensations of itching are related to hay fever, a general mild allergic reaction to plants and pollens. Serious allergic reactions to henna are very rare but they do occur. Compound and adulterated hennas are far more likely to cause allergic reactions, particularly those which have unlisted copper salts or PPD. Ancient Sunrise® henna has purity insured by laboratory testing. If you feel intense itching or wheeze when you apply henna, rinse the henna out immediately, and never use it again. Consult your physician for further advice.



Henna with small clusters of flowers

In the Old Testament, henna is called *camphire*,¹² from the Latin word for henna, henna being an Arabic/Semitic word for *lawsonia inermis*. Henna was a beloved plant growing near Ein Gedi oasis, planted as hedgerows around the vineyards. The fragrant clusters of flowers and dense brushy cover were a favorite place for lovers to spend time together, and love poetry included henna as a metaphor for a loving relationship that was as beneficial as it was enjoyable. As a hedgerow, henna protected the grapes from desert winds and sand. Present-day farmers in tropical, semi-arid zones use henna as a hedgerow to protect their fields against desert encroachment. Henna hedgerows keep wildlife and livestock out of farm gardens and define boundaries. When livestock have been nibbling at henna plants, their lips are stained red-orange as if they're wearing lipstick.

Most of the available lawsone will penetrate and bind to your hair's keratin when you henna your hair. Some lawsone will penetrate the outermost, dead layer of the scalp. About 1% of the lawsone actually in contact with skin migrates into the blood-bearing, living layer of skin. The small amount of lawsone that enters the blood stream is carried away by urine. A few people who leave their henna paste on overnight may be startled to see green urine first thing in the morning, but this seems to be absolutely harmless.¹³ This green is the most oxidized form of the lawsone molecule, transformed from orange to green in the urine's alkalinity. There is no evidence that pure henna used as skin art or hair dye causes cancer and several medical journal articles have been published demonstrating the safety of unadulterated henna.¹⁴ There is presently no contra-indication for using henna during pregnancy or nursing, though if the mother or child has homozygous G6PD deficiency, one's physician should be consulted.

¹² Song of Solomon 1:14

¹³ Asparagus will also harmlessly cause urine to be green. Fortunately, henna does not make urine smell 'skunky' as does asparagus.

Henna should not be used on children who have homozygous G6PD deficiency,¹⁵ a genetic blood enzyme deficiency.¹⁶ Male children are more likely to have homozygous G6PD deficiency than female children.¹⁷ This sex-based genetic characteristic is probably the reason that henna traditions are associated with women rather than men, and adults rather than children. If there is a reason for concern, such as a family history of this enzyme deficiency, a physician can run a simple blood test for G6PD.

Based on the LUKE II pesticide assays that I have run on every henna shipment for the last five years, there is minimal pesticide being used on henna, and papers from the Central Arid Zone Research Institute in Jodhpur, India, corroborate this.¹⁸ The henna in India from the Sojat region rarely has any pesticide residue, other than a trace of synthetic pyrethrum. The lead content of pure henna is rarely higher than the surrounding soil unless it is irrigated by water contaminated by industry runoff.

Henna leaves have only one dominant dye molecule, lawsone, no matter where or how henna grows. There is a narrow range of the amount of lawsone in the leaves based on the climate and soil where the henna was grown, most commonly from about .03% to 2.5% dry weight after milling and sifting. At present, there is no systematic ‘in field’ spectroscopic testing of lawsone content; if such could be accomplished, growers could begin plant genetic improvement and consumers would have a better end product. Leaves are the only part of the henna plant that is in

¹⁴ Kirkland, D., and Marzin, D. “An assessment of the genotoxicity of 2-hydroxy-1,4-naphthoquinone, the natural dye ingredient of Henna,” *Mutation Research - Genetic Toxicology and Environmental Mutagenesis*, volume 537, June 6, 2003.

Marzin, D., and Kirkland, B. “2-hydroxy-1,4-naphthoquinone, the natural dye of Henna, is non-genotoxic in the mouse bone marrow micronucleus test and does not produce oxidative DNA damage in

Chinese hamster ovary cells.” *Mutation Research - Genetic Toxicology and Environmental Mutagenesis*, 2004 May 9;560(1):41-7.

¹⁵ Eghbal, Fariba, Mohammad Reza Fakoorziba, Mohammad Hossein Eghbal, and Soheila Latifnia. 2012. "Survey on causes of hemolysis in Glucose-6-Phosphate Dehydrogenase (G6PD) deficient pediatric patients." *Pakistan Journal Of Medical Sciences* 28, no. 3: 666-669. Academic Search Complete, EBSCOhost (accessed February 26, 2014).

¹⁶ Fariba Eghbal et al. Survey on causes of hemolysis in Glucose-6-Phosphate Dehydrogenase (G6PD) deficient pediatric patients.” *Pakistani Journal of Medical Science*. 2012 Vol. 28 No. 4

¹⁷ Homozygous G6PD deficiency is inherited in the same way as hemophilia, carried harmlessly by the mother on her x chromosome, but presenting in a male child. A physician can determine whether a person has G6PD deficiency with a simple blood test.

¹⁸ Pesticides from neighboring farmer’s vegetable or cotton crop may blow over into henna and settle on the leaves. This ‘pesticide drift’ leaves traces that show up on LUKE II tests. Laboratory tests show henna occasionally has organophosphate pesticide drift from cotton fields; other times it has more benign drift from tomato fields. “Certified Organic” may not include residue from pesticide drift. For this reason, Ancient Sunrise® runs a full panel of tests on every shipment to insure that there is no trace of pesticide. These independent laboratory reports are also part of constructing a research database for henna, indigo, and cassia.

henna hair dye, not wood, roots, or bark.¹⁹ Henna is an earth-friendly crop. It can be grown and harvested without machinery, specialized labor, irrigation, or fertilizer. Henna cultivation requires no fossil fuel.

Demand for PPD-free permanent hair dye will increase because more people are becoming severely allergic to –diamine oxidative dyes and related chemicals. Medical research on the therapeutic potential for henna will progress. Henna plant improvement, processing, and quality should follow to supply a growing market for henna powder of standardized sift, purity, and lawsone content. ‘Mystery mixtures’ marketed as henna have contributed to a perception that henna is an inferior, problematic hair dye, due to faulty medical diagnoses and test result, as well as injuries to people using the products. Ancient Sunrise® products are all tested by an independent laboratory to insure purity for safety and assurance. Ancient Sunrise® will provide a safe way for people who are allergic to chemical hair dye to color their hair, for sensitized stylists to keep their jobs, and for the full therapeutic potential of henna to be realized.²⁰

Pure henna can be used to relieve dandruff,²¹ athlete’s foot,²² head lice,²³ ringworm,²⁴ and pain from diabetic neuropathy.²⁵ Pure henna can be used on a woman’s nipples to relieve thrush, and to decrease the pain of nursing. Only a physician may make a diagnosis or prescribe treatment

¹⁹ It is not unusual for exporters to claim that variously colored henna hair dye products are pure henna, with henna roots and bark added to vary the color. This is false: it is not botanically possible. These compound henna products typically include other unlisted plants and metallic salts. The countries that produce these products do not have laws requiring declaration of ingredients in henna products, and the importing countries, including the USA, often do not require that the importer examine and declare insufficiently or misleadingly declared henna products. Ancient Sunrise® sends every shipment to an independent certified laboratory to insure that there are no contaminants or adulterants in what they sell.

²⁰ Pradhan, Rohan, Prasad Dandawate, Alok Vyas, Subhash Padhye, Bernhard Biersack, Rainer Schobert, Aamir Ahmad, and Fazlul H. Sarkar. 2012. "From Body Art to Anticancer Activities: Perspectives on Medicinal Properties of Henna." *Current Drug Targets* 13, no. 13-14: 1777-1798. Academic Search Complete, EBSCOhost (accessed February 26, 2014).

²¹ Berenji, Fariba, Hassan Rakhshandeh, and Homeyra Ebrahimipour. 2010. "In vitro study of the effects of henna extracts (*Lawsonia inermis*) on *Malassezia* species." *Jundishapur Journal of Microbiology* 3, no. 3: 125-128.

²² Rahmoun, Nadjib, et al. "Antifungal activity of the Algerian *Lawsonia inermis* (henna)." *Pharmaceutical Biology* 51, no. 1 (January 2013): 131-135. Academic Search Complete, EBSCOhost (accessed February 26, 2014).

²³ M. El-Basheir and Mahmoud A. H. Fouad (2002) A Preliminary Pilot survey on Head Lice, Pediculosis in Sharkia Governate and Treatment of Lice with Natural Plant Extracts. *Journal of the Egyptian Society of Parasitology*, Vol 32, No 3, December 2002, Zeinab

²⁴ Bosoglu A., Birdane F., and Solmaz H., (1998) “The Effect of Henna Paste in Ringworm in Calves.”

Department of Internal Medicine, Faculty of Veterinary Medicine, Selcuk University, Konya, Turkiye

Indian Veterinary Journal 75, January

²⁵ Mutluoğlu M, Uzun G., (2009) “Can henna prevent ulceration in diabetic feet at high risk?” *Experimental Diabetes Research*. 2009:107496.

for an illness, but with a physician's permission, pure henna can provide inexpensive and effective relief for these minor irritations.



Henna from different countries stains hair within a narrow range of color, only varying by amount of lawsone produced naturally in the leaves.



There are many wild variants of henna. The flowers may be white (*alba*), pink (*rubra*), red (*miniata*) or yellow, the leaves all contain lawsone. Only chemical additives can make henna blue, green, yellow, violet, or black.

Indigo, *Indigofera Tinctoria*



Indigo, *indigofera tinctoria*

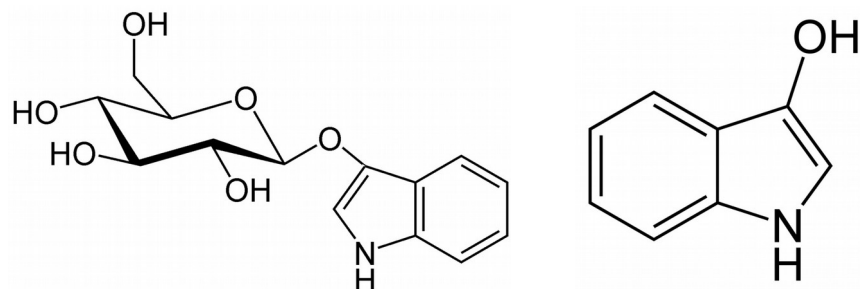
What is indigo?

Indigo, *Indigofera tinctoria*, is a tropical plant that has been used to dye cloth since at least 9,000 BCE.²⁶ Ancient Sunrise® Indigo is still made from fermented indigo leaves as was originally done. Natural indigofera tinctoria dye was a major product of India and West Africa before the invention of synthetic indigo. Ancient Sunrise® Indigo is pure, partially fermented indigo powder, known as *vashma*. Ancient Sunrise® Indigo is pH neutral and safe for hair, free of contaminants, chemicals, pesticides and adulterants. Synthetic indigo has largely replaced natural indigo in the clothing and textile industry today. Synthetic indigo cannot be used to dye hair because the chemicals, alkalinity and heat required can damage hair and skin.

Indigo is a legume, and the indigo powder smells somewhat like peas. Indigo leaves contain indican, a colorless molecule. When the leaves are soaked in water and partially fermented, the indican molecule breaks into β -D-glucose and indoxyl. Indoxyl is the precursor to indigo. These partially fermented precursor-containing leaves are then dried and powdered to make Ancient Sunrise® indigo powder for hair. This powder keeps the indoxyl molecule in the precursor state so it will bind to the keratin and dye your hair. Mix indigo powder with water into a paste, and quickly put it on hair. The indoxyl molecules will migrate from the indoxyl-rich paste into the keratin and bind with it. If the indoxyl molecule is oxidized to the indigo molecule before it has a chance to bind to and stain keratin, it will not bind, and will wash out of your hair. This oxidation happens rapidly, so once you stir water into the powder, you must use the paste

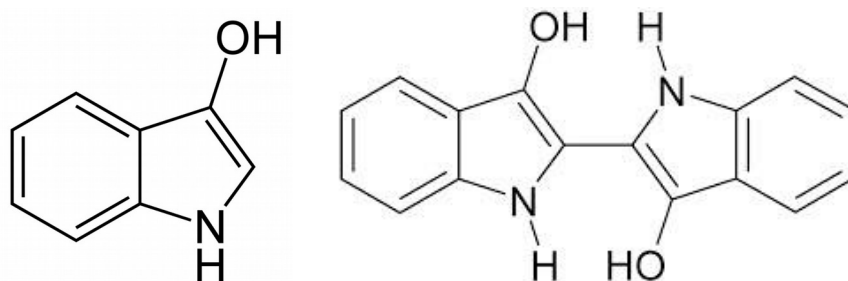
²⁶ This date is based on a Neo-Babylonian Mesopotamian cuneiform tablet that describes dyeing wool with indigo.

immediately so the intermediate indoxyl can dye your hair before it can change to the oxidized indigo molecule which will not bind with and dye hair.²⁷



The indican molecule releases the indoxyl molecule that can dye hair.

You can see the indoxyl precursor dye oxidize and produce the blue indigo molecule if you mix the indigo powder with water and leave it out in the air. The surface of paste will turn metallic dark blue in about twenty minutes when exposed to air. When the paste turns blue, the indoxyl molecule is oxidizing to the blue indigo molecule. The blue indigo molecule will no longer dye hair; the color will wash away.²⁸



The indoxyl molecule changes to the blue indigo molecule. The blue indigo molecule cannot dye hair.

Do not let your indigo powder freeze, be exposed to the air, or to become damp; these will also change the indoxyl molecule to indigo and make it useless for dyeing hair. Your indigo powder or paste will no longer dye hair after it oxidizes to the indigo molecule, the color blue. You cannot freeze your indigo paste for later use as you can freeze and re-use henna paste.

Indigo is not synthesized directly by the plant; it is a product derived from indole glucoside precursors which are secondary metabolites. The indigo precursor, indoxyl, mainly in the form of the glucoside, indican is found in most indigo-producing plants. To form indigo from the

²⁷ Kerry G. Gilbert (nee Stoker) & David T. Cooke. "Dyes from plants: Past usage, present understanding and potential" *Plant Growth Regulation* 34: 57–69, 2001. © 2001 Kluwer Academic Publishers.

²⁸ If indigo chemistry seems bewildering, imagine it as a sort of hair tetris with tetraminos that you can split apart and join back up. At first, you have a tetrimino that is the wrong shape to fit into the available hole. That is the indigene molecule. You smash up the indigene tetrimino. One piece, the indoxyl tetrimino, fits perfectly into the hole, but you must get the indoxyl into that available hole very quickly, or it will join to another piece. If it joins to that other piece, it becomes an indigo, and that again is the wrong shape to fit into the hole.

precursors, the carbohydrate moiety is cleaved from the indoxyl group and two of the resulting indoxyl molecules combine oxidatively to produce an indigo molecule.

Indigo by itself dyes human hair a dull grayish dark blue, like new blue jeans. Though indigo is a blue dye, it does not create purple when mixed with henna; together they create brown. In different proportions, henna and indigo mixes create a broad array of brown tones in hair, conveniently very natural-looking brunette colors.

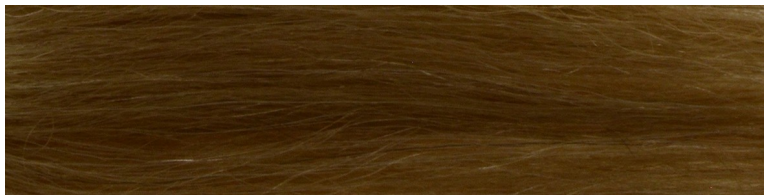


The above image shows an array of henna through indigo colors on white mohair, with henna at the left and indigo at the right and mixtures of henna and indigo in the middle.



Indoxyl green is rarely seen and changes quickly; it's just part of the process of indigo staining hair black or brunette with henna.

If there is a greenish tone after you first dye your hair with indigo mixes, don't panic. This is simply the indoxyl molecule in its green precursor form. The color will rapidly change to the brunette or black tone as it binds to the keratin in your hair, just from being in contact with the air.



Henna and indigo mixed sparingly with cassia produces a lighter, pale brunette color.



Hair dyed with equal parts of henna and indigo

If henna and indigo are mixed evenly, they will produce a medium brunette. If the henna-indigo mix is more henna than indigo, the brunette will be reddish brunette. If the henna-indigo mix has a higher proportion of indigo than henna, the result will be darker brunette. Different fruit acids also change the brunette tone; amla creates darker, more ash tones of brunette. Ancient Sunrise® henna-indigo mixes effectively cover gray and do not fade.



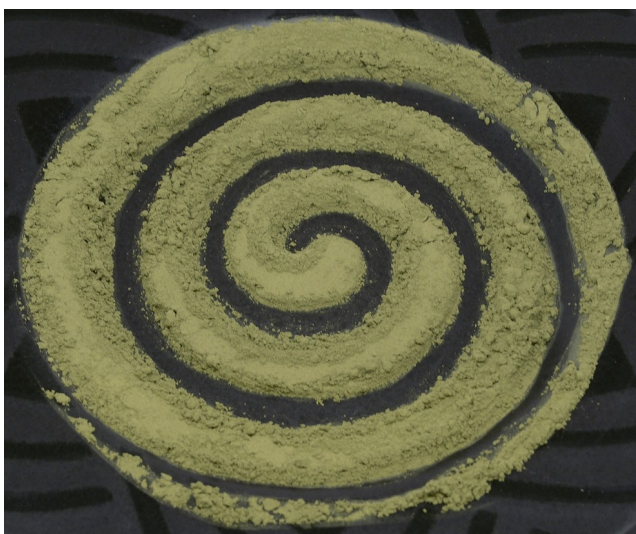
Hair dyed dark brown with $\frac{1}{4}$ Ancient Sunrise® Henna and $\frac{3}{4}$ Ancient Sunrise® Indigo



Hair dyed with henna, and then dyed again with indigo within 48 hours.

When hair is dyed first with henna and then over-dyed with indigo, the hair will be as black as a black cat, even when dyeing over blonde or graying hair. If the indigo fades after many shampoos, and the black color softens, re-dye the hair with henna and indigo to build up the color saturation.

Indigo does not condition and strengthen hair, nor does it have the health benefits as henna. Allergies to indigo are very rare, but they do occur. Most sensations of itching after using indigo are related to hay fever, a general mild allergic response to plant particles and pollens.²⁹ Serious allergic reactions to indigo are very rare but they do occur. Some people also dislike the smell of indigo paste. Mixing indigo powder with instant vanilla pudding powder before adding water masks and relieves this smell. Even when well sifted, the texture of indigo powder is not as easy to apply as henna. Half a teaspoon, or 2 grams of CMC powder, carboxymethyl cellulose powder,³⁰ added to indigo powder before mixing in water improves the texture of indigo paste.



Ancient Sunrise® Indigo Powder

Indigo is not as easy to use to dye hair as henna, because the indoxyl molecule is fragile and finicky, easily oxidizing from indoxyl to insoluble indigo. The process is time consuming. When customers demand fast, cheap, reliable results, manufacturers sell PPD powder as ‘black henna,’ often without labeling the chemical or the amount of chemical used. Ancient Sunrise® indigo powder is always tested to insure that there are no added chemicals, adulterants, contaminants, or pesticide residue, and that the pH is neutral.

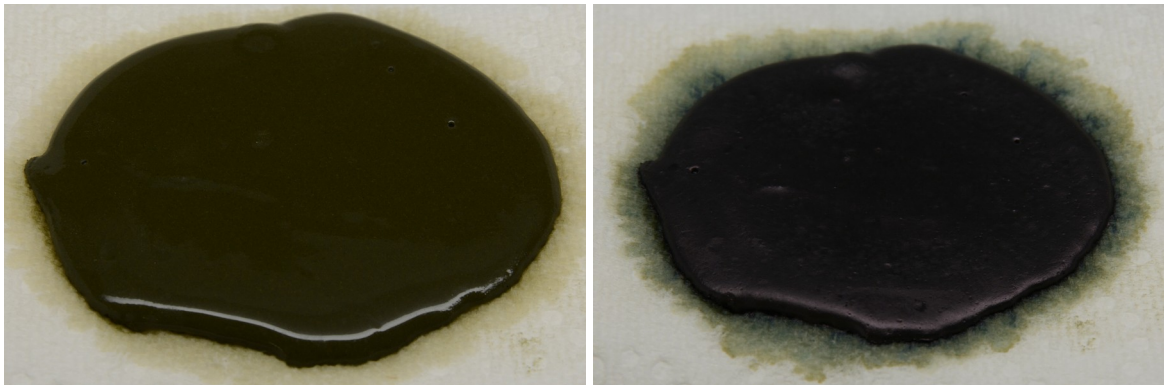
²⁹ I have a mild sense of warm itchiness after using indigo, and after working in the garden. Both are generalized plant allergies, from pollens and plant materials. The indigo itch subsides after a few shampoos, and the gardening itch, after a shower or two.

³⁰ Carboxymethyl cellulose powder is a cellulose gum processed from cornstarch. It is used in salad dressings to give them a creamy texture and keep them from separating.



Hair dyed black with Ancient Sunrise® Henna and Indigo Powders

Ancient Sunrise® sells two qualities of indigo, Zekhara and Sudina. Zekhara is more finely sifted than Sudina. Zekhara indigo is the better choice for fragile or damaged hair, very thick hair, resistant gray hair, locks, or hair with a dense curl pattern. Sudina costs less than Zekhara. If you don't mind rinsing a little longer and if you're not trying to cover resistant gray, Sudina is a perfectly adequate indigo.



Do you want to test your green powder to be certain that it is indigo? Make a small amount of indigo paste with water and powder. The paste should be dark green. Put the paste on a white paper towel, and leave it there for an hour. In one hour, you should see a dark navy blue color on the surface, and blue-green dye seeping out into the paper.

There are many products which claim to be 'black henna' masquerading as indigo. These will be black when you mix them up, and black stain will spread out on the paper towel; these contain para-phenylenediamine, often at dangerously high levels

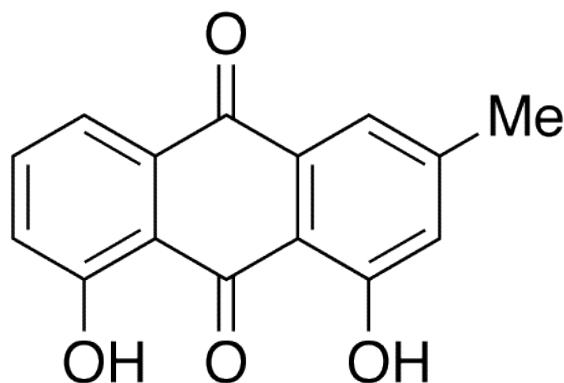
Cassia Obovata



Cassia obovata

What is Cassia Obovata?

Cassia Obovata is a plant grown in East Africa and India and harvested for use in folk medicine hair as well as the hair care industry. Ancient Sunrise® Cassia obovata is 100% pure powdered, dried cassia leaves. Cassia powder has a pleasant smell similar to a heap of warm mowed grass. Cassia leaves and flowers contain chrysophanic acid (chrysophanol), a golden yellow anthraquinone molecule, chrysophanol (1,8-Dihydroxy-3-methylantraquinone). The chrysophanic acid in cassia can dye pale or gray hair a golden-wheat color, but the stain is not as permanent as henna. The dye is translucent and does not make dark hair a lighter color.



Chrysophanic acid (1,8-dihydroxy-3-methylantraquinone)

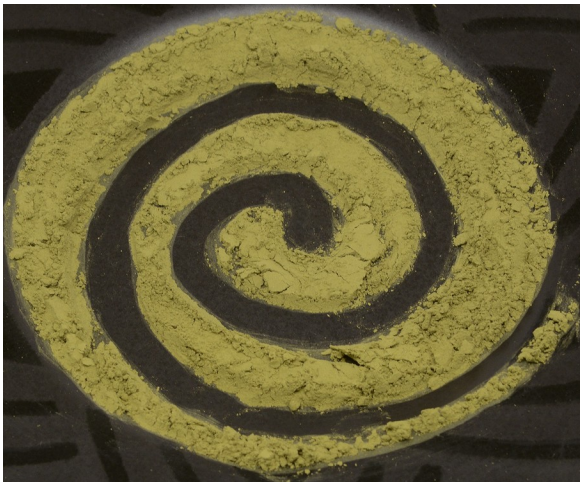
Cassia obovata is an excellent hair conditioner; it makes hair glossy and thick, and keeps the scalp healthy. Mix the green cassia leaf powder with warm water and apply it to hair for an hour to condition hair. Mix cassia powder with a mildly acidic liquid and allow the mix to rest

overnight to release the intermediate dye molecule; apply to hair for several hours for a light golden stain.



Cassia obovata stains gray and white hair a wheat color with golden tones. This stain is not visible on dark hair. Cassia can condition and strengthen dark hair without changing the color.

The tannins and chrysophanic acid in cassia leaves have anti-fungal and anti-bacterial actions on skin. Refined chrysophanic acid is used to formulate topical eczema medications. Ancient Sunrise® cassia naturally contains chrysophanic acid and many of our clients report scalp eczema relief when they use cassia on their hair. Only a physician can diagnose or treat diseases. With a physician's permission, pure cassia, applied as a paste, may be used to relieve eczema symptoms.



Ancient Sunrise® Cassia obovata powder.

The tannins in cassia obovata can restore a soft texture to hair that has been damaged from bleach. Ancient Sunrise® has no metallic salts, chemical dyes or adulterants; it does not react adversely with other chemical hair products.

Cassia's tannins are particularly helpful for people with fragile relaxed and natural hair. Cassia can strengthen hair that has been damaged by relaxers, and relieve some scalp conditions caused by chemical treatments. When hair is fragile, has a very tight curl pattern and tends to break off, cassia can help hair grow longer by strengthening the hair and helping to maintain a healthy scalp. Cassia can restore the strength of hair damaged by swimming, chemical treatments, drying and UV damage from sunshine.

If the water you use to wash your hair is full of dissolved minerals, the minerals can accumulate in your hair. Some of those minerals may react with the cassia and turn your hair green, dark brown, or greenish black. Please test cassia on some hair harvested from your hairbrush! If the color looks strange, treat your hair with Ancient Sunrise® Rainwash from mehandi.com to remove the minerals before you dye your hair with cassia.



Cassia obovata flowers with seed pods beginning to form.

Cassia obovata is also known as cassia italica, senna obovata, and senna italica. Cassia and Senna are used often interchangeably in botanical texts. The seeds and leaves of cassia (*senna alexandrina*³¹) contain sennosides; they are powdered and taken internally as a laxative, Senna. Powdered cassia obovata leaves do not have a laxative effect when applied to skin and hair.

³¹ The laxative product marketed as 'senna' should not be used for hair conditioning or hair dye. Senna is a botanical cousin of Cassia Obovata, but is not the same plant.