Henna, Cassia, and Mildly Acidic Mixes

Henna and an acidic mix versus henna mixed with water

Henna was mixed with lemon juice with lemon juice and applied to the hair at the left, seen above. Henna was mixed with boiling water and applied to the swatch on the right. When the henna was rinsed out, the swatch with the lemon mix was a paler orange, and the swatch mixed with water was a brighter orange. Over several months, the mildly acidic stain shown at left gradually darkened while the water stain gradually faded. This is because the aglycone intermediate cannot develop in boiling water, so the stain cannot effectively bind to the hair. The darker hair was created by dying with henna mixed with a mildly acidic paste that had been left to develop for about twelve hours at about 70F. This released the intermediate aglycone from the lawsone precursor in the leaf. The aglycone form of lawsone in the henna will bind permanently to keratin without boiling[1] or mordants[2] if mixed with a mildly acidic liquid.[3] The acid penetrates the cellulostic material in the powdered leaves, and makes the lawsone available for binding, as the precursor is converted to the aglycone intermediate. As long as the mix is hydrogen-rich and mildly acidic[4] the hydrogens on the corners of the molecule will be preserved

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[1] Most dye molecules are large. When dyeing fabric, the dyer often boils the cloth or yarn in a dye bath. The heat expands the molecules so that the fiber will take up these large molecules more easily. Lawsone, chrysophanyl, and indoxyl are unusually small dye molecules that will bind to keratin without boiling. Don't boil your head.

[2] A mordant is a chemical that partially breaks up fiber so that dye will bind to it more easily. Most mordants would be harmful to hair or toxic to skin. Stylists often use a 'soap cap,' a mix of detergent and peroxide to damage hair a bit so that dye will more easily adhere to the hair. Lawsone, chrysophanyl, and indoxyl have molecular shapes that will bind with keratin molecules without a mordant.

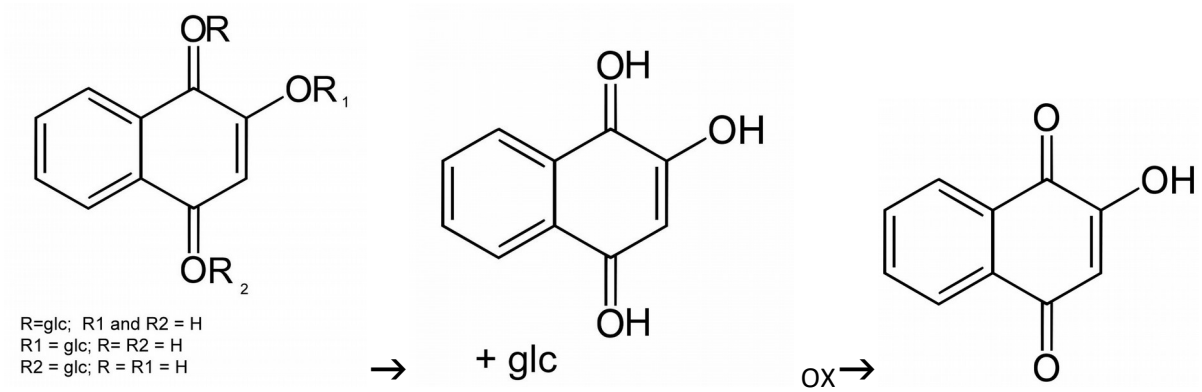
[3] James , K. C., Spanoudi , S. P., Turner, T. D.. 1986 "The absorption of lawsone and henna by bleached wool felt" K. C. Society of Cosmetic Chemists, Vol. 37, No. 5, 359-367.

[4] Any acidic liquid from pH2.0 to pH4.5 added to the pH neutral henna powder will make a satisfactory henna paste. Your choice of paste will depend on what smell you like, and how sensitive your skin is, and what other enzymes, anti-oxidants, or factors you want to work with.

in the intermediate aglycone state, the dye will bind to the keratin of hair in a Michael reaction.[5] Lawsone binds so strongly with a Michael addition to keratin that even repeated bleaching will not completely remove the color. Lawsone does not 'coat' the hair, it binds into the keratin scales that make up the outside layer of the hair. Once bound into hair, the lawsone molecule will gradually darken, unless something is done to prevent that darkening.

Fruit juices with their differing pH, differing kinds of acid, anti-oxidants, pigments and enzymes slightly change the tone, saturation, and oxidation of lawsone and chrysophanic acid in hair.[6]

[5]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.



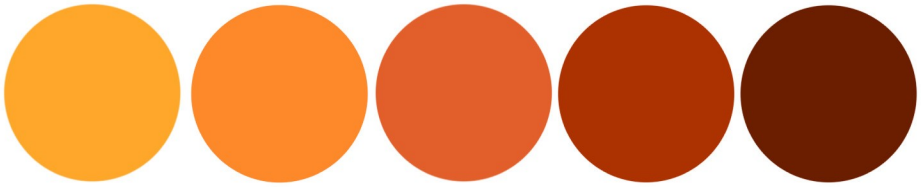
The sequence of henna dye release

The henna leaf has a lawsone precursor and intermediate.

The lawsone precursor is converted to 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. In 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 bindable aglycone form of the lawsone molecule will graduallybecome lawsone. This is termed 'demise' of the henna paste. In demise, 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 lawsone and leave weak stains on keratin. This usually happens in about one week at room temperature. This demised henna paste stains keratin a weak orange color which will not darken because it can no longer bind through Michael Addition.

[6] These variants are difficult to quantify and every person's hair is slightly different. In this book, I decided to not post images of the varying results we got testing mixes on hair, because every person will get slightly different results from their mix, and the color resolution on each person's monitor (or printer) is slightly different. Please understand that these colors represented are a very rough approximation of what you might get as results. Test mixes on your own hair until you find your favorite, then stick with it. I recommend that stylists do their own tests on harvested human hair to become familiar with the range.

Cassia stains range from minimal or no color in a pH neutral mix, to a golden stain color from an acidic mix because cassia has a similar precursor-intermediate sequence to henna. Cassia's intermediate binds most effectively to keratin, so a paste with intermediates released and ready to bind to keratin is the most effective.



The color progression of henna dyed hair as it oxidizes over time: it will not fade. Hennaed hair will gradually darken.

If henna is mixed with a very sour liquid, the stain will be a very light coppery orange at first and gradually darken towards deep auburn. If henna is mixed with a pH neutral mix, the stain will begin at a medium red-orange, but darken only minimally.

Fruit juices are chemically complex, highly variable, and may contain many different acids, as well as other enzymes and pigments. They vary in price, and have distinctive odors and textures when they are mixed into henna. The color of the fruit or juice generally has little to do with the color the dye produced. Blueberry juice does not actually make henna more blue; tea does not make henna browner. Try a few things until you find out what works best for you, what is most convenient for you, and what fits into your budget.

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