

## The Molecular Sequence of Henna Dye Release

Copyright © 2016 TapDancing Lizard ® LLC Catherine Cartwright-Jones PhD

Hennapage.com

You may link to, quote, and use this information only if you cite source.



Henna is *lawsonia inermis*, a small tropical tree which grows in semi-arid zones. Powdered henna leaves contain 0.5% to 3% lawsone, a red-orange naphthaquinone molecule<sup>1</sup> 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.<sup>2</sup> 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 is as follows:<sup>3</sup>

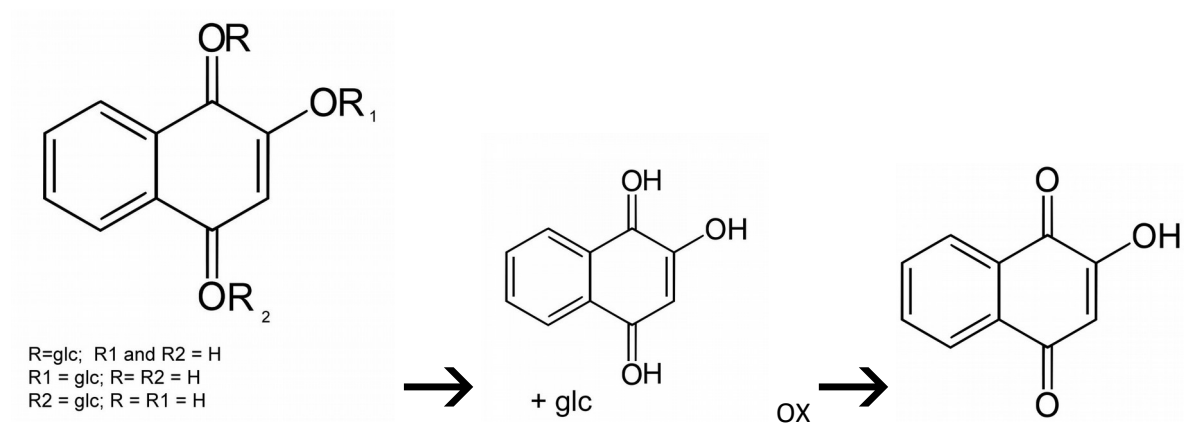
- 1) Lawsone is derived from hennocide precursors in the henna leaf.
- 2) The three isomerglucocides (hennocides) are converted into the aglycone by hydrolysis in mildly acidic conditions. These will bind to keratin.

<sup>1</sup> HPLC laboratory results, Alkemist Laboratories for TapDancing Lizard LLC, 2008 - 2016

<sup>2</sup> 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

<sup>3</sup> 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

3) Then, further transformation of the aglycone leads to the more stable lawsone by oxidation.



This transformation is gradual at room temperature. It proceeds more quickly in warm conditions and slows under cold conditions.

Once all of the unstable aglycones have transformed to the stable form, in about one week at room temperature, henna will stain keratin a weak orange color which will not bind through Michael Addition and will not darken. In henna work, this is referred to as demise.

### Dye release: a layman's guide to henna paste and 'is it ready yet'

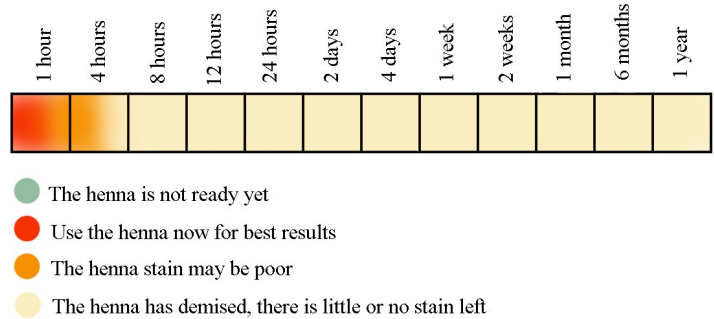
If you hold henna leaves in your hand, your hand will not be stained. You have to break down the henna leaves in one way or another to release the dye molecule, lawsone.<sup>4</sup> The henna leaves have to be crushed. Ancient Sunrise® makes sure their suppliers crush and sift henna leaves to a high standard, higher than other henna hair dye suppliers. After the henna leaves are crushed and sifted, the henna pulp or powder has to be mixed with a liquid to help the lawsone molecule migrate out of the plant pulp. If the mix is acidic when the lawsone molecules migrate, the hydrogens will stay attached and will be ready to bind to the keratin in your hair.<sup>5</sup> That's the optimal time to put henna into your hair. If lawsones aren't in contact with keratin during this optimal time, they'll bind with the free oxygen in the paste or in the air, and stain hair weakly or not at all.

Adding heat to the process of dye release makes release go faster. Cooling the process makes it go slower. I prefer the slower, cooler dye release sequences because you get better long term

<sup>4</sup> There are some folkloric traditions comparing henna to a woman, in that both become more beautiful after they've been through hardship.

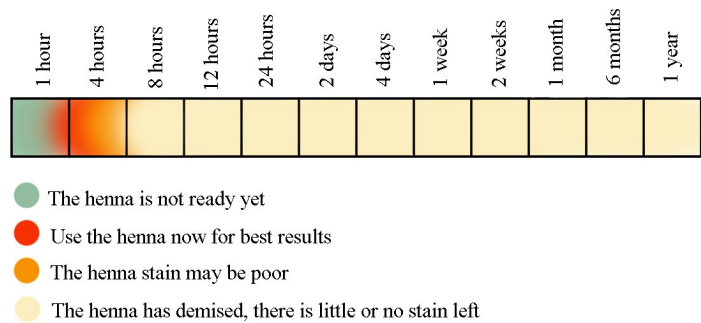
<sup>5</sup> Compare this to tea stains on a white tablecloth. A dry tea bag on a tablecloth won't leave a stain. A wet teabag will stain a tablecloth: the molecules migrated from the teabag through the liquid into the tablecloth.

results. The cooler mixes are more forgiving, give more natural-looking results, and you have a longer window of opportunity for using the paste. Here is a series of time tables for mixing and using. All of these times are approximate. The enzymes in fresh fruit juice tend to make the process move faster. Purified citric or acetic acid makes the process move slower.



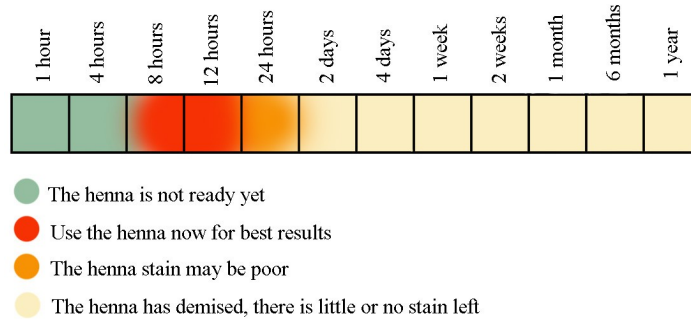
### Henna and boiling liquid

If you add near boiling liquid to henna powder, the paste will be ready immediately. Do not delay using a hot paste, because the lawsones oxidize and demise very quickly. A hot paste mix is a good stop gap if you have a henna emergency, throw out any leftovers.



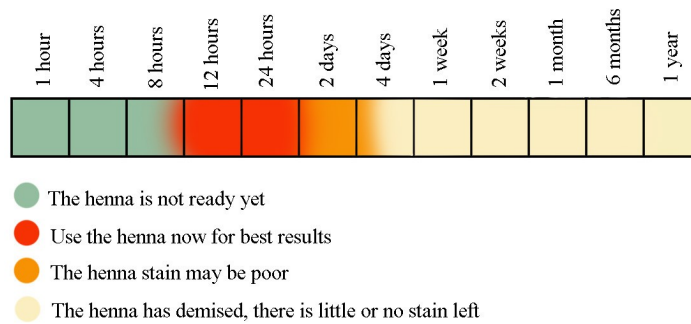
### Henna in a hot place, 100F to 140F or 37 to 60 C

If you're in a hurry and don't want your henna to go brassy, put your henna mix in the car, in the sun, with the windows rolled up, or some other place that's 100F to 140F, 37 to 60 C. Check your paste in one hour for dye release. Do not put your henna paste in the oven or microwave; ovens heat the paste unevenly.



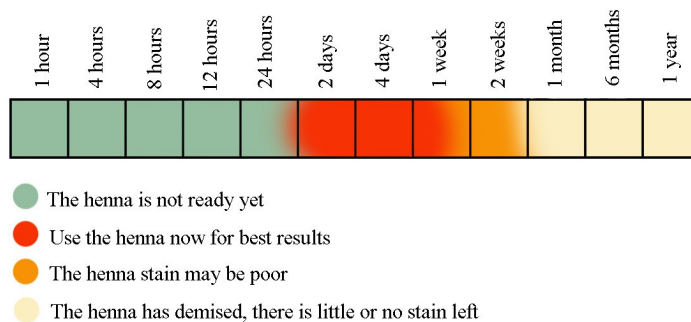
### Henna on a warm day, 80F or 26 C

If you have a warm room or on a warm day, 80F or 26 C, mix your henna in the morning and it will be ready in the afternoon or evening. If you can't use it twelve hours after you mixed it, cover the paste and put it in your refrigerator or freezer, to save it for later.



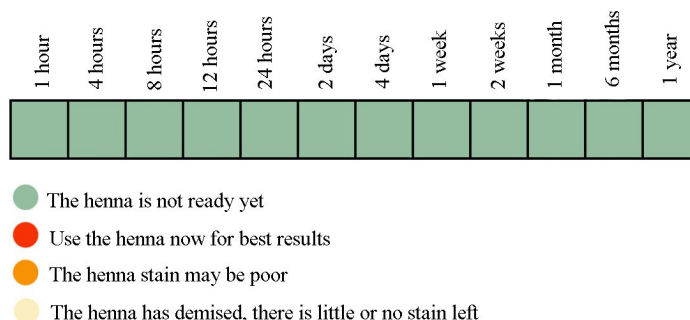
### Henna on a cool day, 65F or 18C

If it is a temperate, mild day or in a cool indoor setting, 65F or 18C, mix your henna the night or day before you intend to use it. If you haven't had a chance to use your henna by the second day, put it in the refrigerator or freezer and save it for later.



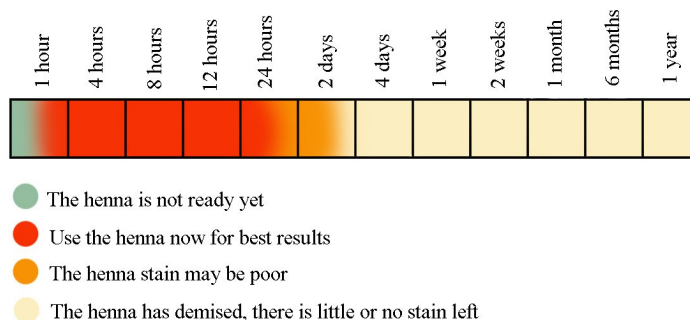
### Henna in a cold place, 40F or 4 C

If you aren't sure when you can use your henna, mix it and put it in the refrigerator at 40F or 4 C. It will be ready in about two days, or you can leave it there for a week, and your paste will be ready and waiting for you.



### Henna in the freezer, 25F or -4C

If you mix henna and immediately put it in the freezer, it will remain on the verge of dye release indefinitely. When you are ready to use your frozen henna paste, just thaw it and use it or keep it in the refrigerator. Frozen and thawed henna kept in the refrigerator will be ready to use for several days. If you are mixing henna for a salon or customers, I recommend that you mix large amounts of henna paste when you have some spare time, then freeze it to be thawed when you need it. Thawing small packets of henna as needed eliminates wasted henna and wasted time. Re-frozen and re-thawed henna has reduced dye content.



### Henna in the freezer, mixed and allowed to release dye prior to freezing, then thawed

If you allow your henna to release dye before you freeze your henna paste, your henna will be ready to use as soon as it thaws. Freeze it in small packets, ziplock bags, carrot bags, or ice cube trays. If you freeze your henna in these small packets, you can quickly touch up gray if you don't have time to henna all your hair. Many people report that frozen henna gives an especially robust color, probably because the freeze-thaw process assists the breakdown of cellulose and henna leaf cells.<sup>6</sup> You can either freeze the paste without dye release, or you can do dye release, then freeze. Mix a kilo of henna at a time in a large bowl. It's cumbersome to mix more than one kilo at a time. If you anticipate using five kilos of henna over many months or clients, use several

<sup>6</sup> In gardens, henna leaves become limp and dead if temperatures fall below freezing.

bowls. When you have a large amount henna paste mixed to your favorite consistency, spoon it into a small food chopper and whirl smooth.