Lac Dye in Medieval Persia

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with special thanks to Mistress AnneLiese Wolkenhaar for her assistance in redacting the recipe

Complete Description of Lac Dye Experiment

> "*Let a specific weight of lac be forced through indigo. Let the indigo be crushed to extract its pure liquid. Silk immersed in this liquid will be red. But if the amount of lac be insufficient or if the silk be immersed in the fluid of freshly-crushed indigo then the color will be something between violet and red. If red dye be missed with the lac then the color will be false. Let the silk to be dyed be fine and let both strands be spun so that it will be imbued with the dye*."[1]

The quote above, from the Bursa Trade Guild law of 1502, emphasizes the time and care that must be taken to dye with lac (lac is a dye derived from insects). Lac dye has been used in Persia since at least 714 B.C.[2] According to Dr. Paul Mushak, an expert in chemical analysis of rug dyes, lac dye "…was the principal red dye used in classical Persian carpets..."[3] Lac was primarily used to dye silk,[4] yielding a range of colors from rose to purple.

Lac dye is one of four commonly used insect dyes in medieval Persia. Lac was cultivated in Northern India and imported into Persia. It was obtained from the insect Laccifer lacca, which is a type of parasite found on trees.[5] The insects were scraped off the trees by women laborers. Sticklac, a secretion released by this insect as part of its lifecycle, is the actual substance used to produce the dye. Approximately 6% of the sticklac is the dye.[6] Lac dye is still produced in the same way as it was in medieval times.

Dye recipes are difficult to obtain. Similar to Europe, Persian dye recipes were closely guarded secrets, passed from father to son.[7] I started with a Persian recipe with an uncertain date. According to Oriental Rugs, published in 1937, the recipe was obtained by Mr. Harris from a book by a Mr. Harris, a dyer in India who claimed to be descended from 20 generations of dyers, originally from Tabriz. He stated the recipes came from a book of Persian dyes, originally owned by his grandfather.[8] I have not yet been able to obtain the original source (the book by Harris). However, it could not have been published any later than 1937, the date the book Oriental Rugs was published. This would date the copy owned by the dyer in Tabriz to perhaps the 18th century or earlier (depending upon the publication date of the original source and the age of the dyer, his father and grandfather). I could not find any other dye recipes from Persia. Most references state that they are not aware of any medieval dye recipes from this region of the world. The dye recipe is as follows:

> "*Persian Scarlet. Take the lac colour, and if you choose a little cochineal for richness, and soak from four to six days; strain it in two cloths and add alum and a little turmeric; let it stand for three hours. Put wool in and steep for twenty-four hours, then boil for two hours. Take out the wool and add mineral acid; re-enter wool and boil an hour more. Wash fifteen minutes when cold, and dry in the shade*."[9]

European recipes provided no assistance in further interpreting this recipe, as lac was typically not used in Europe.[10]

A further difficulty with this recipe is the translation. The original source I found this recipe in was The Traditional Crafts of Persia.[11] Mr. Wulff's book referenced a book by Walter Hawley. The two translations are not exactly the same. The recipe in Wullf states to add "minerals salts" to the dye bath while the recipe in the Harris book, states to add "mineral acids." This highlights the difficulty of using non-primary sources. Unfortunately, Mr. Hawley actually obtained the recipe from an earlier book by a Mr. Harris who obtained the recipe by translating the book of dyes from a dyer in India. It is difficult to say if the recipe in the book by Harris is an accurate translation of the recipe.

Besides this version being the third recopying of this recipe, Farsi[12] has unique transliteration challenges as well. The Farsi alphabet has more characters than the English alphabet. These additional letters do not have English equivalents. There are several different accepted transliteration systems in use, all of which have their strengths and weaknesses. Most of the

standardized transliteration systems were not developed until the twentieth century. Depending upon the time frame of the transliteration, the author often made up their own system. Further confounding this issue is the lack of vowels. Vowels are represented in Farsi by different markings placed above or below the different letters. They are typically only used consistently in the most formal of writings. Without the vowel markings, several words appear to be the same. The reader uses his familiarity with the language combined with context clues to interpret Farsi.

The translation of the word "cochineal" is problematic as well. Even today, dyers frequently confuse the various types of cochineal dye in use in the Middle East.[13] The medieval Persian dyer had access to four types of cochineal; Ararat cochineal (also known as Armenian Cochineal and Kirmīz[14]), Indian cochineal, Armenian cochineal, Polish cochineal and in late period, Mexican cochineal. All of the above listed dyes come from different species of insects and produce slightly different shades of red. The term "cochineal" is used interchangeably for all four dyes. Considering the potential time frame of this recipe, it is possible that any of these four dyes could be the optional ingredient. Kirmīz is the most likely dye additive as this was the most common used cochineal by Persian dyers,[15] however, today this dye is not generally available outside of Armenia. As a result, I chose to not use the optional addition of "cochineal" mentioned in the recipe.

As is typical of medieval recipes, the amounts of the ingredients are not listed. As a starting point, I looked at several modern dye recipes for lac. All of the recipes I consulted contained the same warning regarding lac dye. Lac dye is difficult to dissolve and requires an acidic pH to dissolve completely. This explains the four to six days of soaking time for the lac dye required to prepare the dye bath in my chosen recipe. Unlike in my chosen recipe, modern recipes reduce this time by adding some kind of acidic compound to either the pre-mordant phase or the dye bath preparation phase. Tartaric acid was the most common addition to the pre-mordant phase.[16]

I decided to interpret the transliteration by Harris of "mineral acids" as the correct translation. It seemed logical to me that Persian dyers had discovered the improved dissolving of lac dye with the addition of an acidic compound. Persian dyers were renowned for their expertise in dyeing, able to produce a wide range of color fast dyes.[17] They experimented extensively (natural dye colors can be affected by a wide range of variations from water quality to the time of day harvested[18]) to obtain the best possible colors.

I chose to use tartaric acid as it was the most common addition in the modern recipes to lac dye and it was available in medieval Persia. Tartaric acid is a byproduct from grapes, produced in the wine making industry.[19] I choose to use 3% of the WOG[20] (dry weight of goods being dyed) as this was usually the amount listed in modern dye recipes. The dye has not changed in the several hundred years of its use; therefore I reasoned that as this amount is the accepted amount today, it probably did not differ significantly from medieval times.

Alum (known as zāj in Farsi[21]) has been identified through spectral analysis of several medieval Persian textiles and rugs.[22] Alum was also the mordant listed in all modern lac dye recipes I reviewed.[23] Alum amounts ranged from 8 to 25%. I chose to use 12% alum as most recipes indicated this amount was sufficient.

I chose to use 8% WOG for the amount of lac dye I used. This amount was fairly constant across all modern dyes for dyeing the darkest shades of lac. I wanted to use the recipe for darkest shade as I have very hard water with high calcium content and The Natural Dye Instruction Booklet cautioned that lac dye will not dye its "darkest" shade in hard water.[24] I felt that by using the highest amount I had a better chance of the dye working. This worked out to 0.5.ounce of lac dye for the amount of silk I intended to dye. I mixed the 0.5 ounce of lac dye in two gallons of water. I needed two gallons of water to

assure enough solution to cover the fabric completely. In medieval Persia, dye pots would have been ceramic. I used aluminum pots as that was the type of pot that I had access to as the cost of ceramic lined pots was out of my price range.

I put the lac into the water and then brought the solution to a boil in an aluminum pot for 15 minutes. While the Persian recipe did not state to do this, I was concerned regarding the relatively low temperature of my house. In Tabriz, the average daily temperature for this time of year is 12.2° C (53.96°F)[25], while the time frame I was preparing the dye bath was around 10°C (50°F) in my house. I hoped that by starting at a higher temperature the lac dye would dissolve better in cooler temperatures. I then allowed the lac to sit for a full six days.

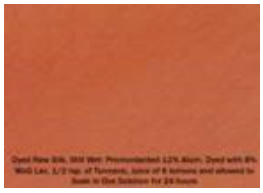
On the 6th day I strained the lac dye using 2 cotton gauze cloths, stretched over another pot. I was very surprised at the amount of time it took to strain the dye. Considering I was removing several hundred insect shells, I should not have been so surprised. It took almost an hour to strain the dye. Note the "clumps around the edges of the cloth in the picture below—those are the insect shells.

I was not able to remove all shells completely, but was able to remove most of them. The lac shells had a tendency to "clump" and block the holes in the cotton gauze.

I dyed five items; four 8mm silk habatoi scarves and two yards of raw silk. I was curious to see if the raw silk would dye differently than the finished silk, with all gum removed. For the raw silk, I used the lac stock that had soaked for 6 dyes. I decided to experiment further and use a modern recipe from the Dye Works[26] with the addition of ½ teaspoon of turmeric in order to obtain the same range of colors as the Harris recipe. The modern recipe called for adding drops of "acetic acid, citric acid or lemon juice" to the dye pot prior to placing fabric in to dissolve the lac. It recommended aiming for a pH of 4. I felt that this was a likely method that some dyers my have employed as lemons were available in Persia during the medieval period. Lemons were grown throughout the Mediterranean region, China , India and Persia . Other citrus fruits were also available to the Persian dyer.

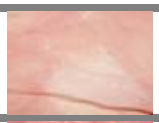
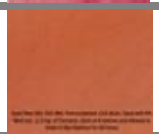
I opted to not use pH paper as the Persian dyers from this time frame would not have had that available. I simply applied lemon juice from fresh lemons until the dye cleared. It took 6 lemons to clear the dye bath of most of the lac beetle shells.

At this point, I simmered the dye pot for 1 hour, per the recipe's instructions and then added the wet, mordanted fabric (I pre-mordanted the fabric with 12% alum prior to dyeing) and simmered for one more hour. At this point, I had a very light shade of an orangey rose. I was unhappy with the light tone of the color, so I decided to allow the fabric to sit in the dye pot for another 24 hours. The Natural Dyers Instruction Booklet mentioned that at 24 hours, the fabric will have absorbed the maximum amount of benefit from the lac dye.[27] The color deepened slightly with the 24 hours of soaking.



I believe multiple factors may have contributed to the lac of dye uptake by the raw silk; the silk "gum" still present on raw silk, the high calcium carbonate content of my water, the low temperature in the house, too low or too high a pH, the uncertain quality of the lac dye or the wrong amounts of all ingredients used. Further experimentation would be necessary to determine the correct process for dyeing raw silk with lac.

I followed the Harris recipe for the four silk scarves, varying the amount of turmeric from $^{1}/_{8}$ tsp to $^{1}/_{16}$ tsp. Two of the scarves I pre-mordanted with 12% alum and 3% tartaric acid to see if the pre-mordanting process increased dye uptake by the fabric. Unfortunately my first attempt resulted in uneven dying. I had not anticipated the amount of dye bath that would boil away during the final process. As a result, I had to stop the process part way through to add additional water (after removing the silk). See table on following pages for results of failed dye process.

	Pre-mordant	Lac	Turmeric	Alum to Dye Bath	Tartaric Acid to Dye Bath	Photo
Scarf A, Failure	No	8%	¼ tsp.	12%	3%	
Scarf B, Failure	No	8%	½ tsp.	12%	3%	
Scarf C, Failure	Yes: 12% Alum, 3% Tartaric Acid	8%	¼ tsp.	12%	3%	
Scarf D, Failure	Yes: 12% Alum, 3% Tartaric Acid	8%	½ tsp.	12%	3%	
Raw Silk	***Yes: 12% Alum***	*8% juice of 6 lemons*	*½ tsp.*	*None*	*None*	

I repeated the process with one difference; I increased the amount of dye bath to compensate for the amount that will boil off in the final process. The resulting scarves are on the display board.

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[1] Bursa Trade Guild's law of 1502, Pamuklu, Yünveipek Kumas Koleksiyonu: Cotton, Woolen and Silk Fabrics, Hülya Tezcan, Uapi Kredi Yayinlari Ltd., 1993, Pg. 48

[2] The Traditional Crafts of Persia, Hans E. Wulff, M.I.T. Press, 1966, Pg. 189

[3] "*Unfulfilled Promise,"* J. Barry O'Connell, Jr., *Oriental Rug Review*, Volume 8, http://www.rugreview.com/barwert.htm

[4] The Persian Velvets at Rosenburg, Carol Bier, Copenhagen, 1995

[5] Information obtained from the Food and Agricultural Information of the United Nations, http://www.fao.org/docrep/V8879e08.htm

[6] "Natural Dye Instruction Booklet," Michele Wipplinger, Earthues, May 2002, Pg. 40

[7] The Traditional Crafts of Persia, Hans E. Wulff, M.I.T. Press, 1966, Pg. 188

[8] Oriental Rugs: Antique and Modern, Walter Hawley, Tudor Publishing Company, NY 1937, Pgs. 40-41

[9] Oriental Rugs: Antique and Modern, Walter Hawley, Tudor Publishing Company, NY 1937, Pg. 41

[10] Segreti per Colori (Secrets of Color), mid 15th century manuscript in Latinized Italian lists oricello (a dye obtained from the plant Orchil), verizino (brazil wood) and madder as dyes to make the colors in the red tones. Translation by Mary Manfield, "Original Treatises on the Arts of Painting", published in 1849. http://www.costume.dm.net/dyes/segreti.htm

[11] The Traditional Crafts of Persia, Hans E. Wulff, M.I.T. Press, 1966, Pg. 188

[12] Farsi is the name for the Persian language.

[13] *"The Use of Insect Dyes In Oriental Rugs and Textiles: Some Unresolved Issues,"*, Dr. Paul Mushak, Oriental Rug Auction Review, Volume 1, No. 1, March 1981, Pg. 33

[14] *"The Use of Insect Dyes In Oriental Rugs and Textiles: Some Unresolved Issues,"*, Dr. Paul Mushak, Oriental Rug Auction Review, Volume 1, No. 1, March 1981, Pg. 34

[15] Oriental Rugs: Antique and Modern, Walter Hawley, Tudor Publishing Company, NY 1937, Pg. 35

[16] I consulted http://www.thedyeworks.com, "Natural Dye Instruction Booklet," Michele Wipplinger, Earthues, May 2002, Pg. 40, http://aurorasilk.com, and The Household Cyclopedia of General Information, published in 1881, http://www.publicbookshelf.com/public_html/The_Household_Cyclopedia_of_General_Information.com

[17] Oriental Rugs: Antique and Modern, Walter Hawley, Tudor Publishing Company, NY 1937, Pg. 39
[18] Oriental Rugs: Antique and Modern, Walter Hawley, Tudor Publishing Company, NY 1937, Pg. 41
[19] -http://www.abrlundberg.se/lundberg/html/eng_html/products/tartaricacid.htm
[20] "Natural Dye Instruction Booklet," Michele Wipplinger, Earthues, May 2002, Pg. 40
[21] The Traditional Crafts of Persia, Hans E. Wulff, M.I.T. Press, 1966, Pg. 189
[22] "*The Detection of Metallic Mordants by Energy Dispersive X-Ray Spectrometry,"* R.J. Koestler, N. Indictor, And R. Sheryll, Journal of the American Institute for Conservation, Volume 24, No. 2, Pgs. 110-115
[23] -I consulted http://www.thedyeworks.com, "Natural Dye Instruction Booklet," Michele Wipplinger, Earthues, May 2002, Pg. 40, http://aurorasilk.com, and The Household Cyclopedia of General Information, published in 1881, http://www.publicbookshelf.com/public_html /The_Household_Cyclopedia_of_General_Information.com
[24] "Natural Dye Instruction Booklet," Michele Wipplinger, Earthues, May 2002, Pg. 40
[25] Iranian Meteorological Organization Data Processing Center, Average Daily Temperatures in Tabriz from 1964 to 1976
[26] http://www.thedyeworks.com/instructions/lac.html
[27] "Natural Dye Instruction Booklet," Michele Wipplinger, Earthues, May 2002, Pg. 40