

NATURAL PLANT DYES

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Dyeing materials with plants is an ancient art practiced since biblical times. There are many plant materials that can be used for dyeing yarns and materials: roots, bark, leaves, berries, seeds, twigs, branches, tubers, and nut hulls, each capable of producing a range of colors with various mordants and yarns. In addition, when properly applied, natural dyes are fast, resisting fading due to exposure to sunlight.

Although there are many recipes for natural dyes, this experiment will only be concerned with a simple recipe for the preparation of a dye bath and the use of mordants to provide a variation in colors.

Mordants are chemical additives that sometimes help a fiber accept a dye that it might otherwise reject. (The word mordant comes from the Latin "morders" which means "to bite") Some of the more common mordants are listed in the table below.

Table of Common Mordants

Common Name	Chemical Name	Use
Alum plus Cream of tartar	Aluminum potassium sulfate Potassium bitartrate	Usually combined in a ratio of 3 parts alum to 1 part cream of tartar
Chrome	potassium dichromate	Used to deepen colors and make them more lasting
Iron (copperas)	Iron(II) sulfate	used as a saddening agent because it makes a color darker or duller
Tin	Tin(II) chloride	used as a brightening agent to make color sharper or lighter
Copper sulfate (blue vitriol)	copper(II) sulfate	used to make colors in the green range as it itself imparts a bluish-green color to fibers
Vinegar	Acetic acid	used to heighten color of a dye bath, especially with reds
Ammonia (non-sudsy, clear)	Ammonia	used to draw colors out of dye materials, especially grasses and lichens

Although you will be doing this process as a laboratory exercise, it is, not necessary to work in a laboratory or with highly technical equipment to do natural dyeing. You can easily work on a kitchen range, household-type hot plate or even an open fire and get equally good results. Remember to use soft water and utensils made of glass, stainless steel or enamel in order to get true colors. Don't forget to protect your hands with rubber gloves to prevent dye stains and to prevent excessive exposure to mordants.

Safety Precautions

Wear goggles at all times in the laboratory

Wear rubber or plastic gloves when working with mordants and dye baths.

All the mordants used in this experiment can cause minor respiratory irritations if inhaled and possible mild skin irritation. In the event of skin contact, wash the affected areas with water.

Disposal

Dispose of all mordant solutions in the containers provided in the laboratory.

Solutions of natural plant dyes can be poured down the drain with running water.

Materials Needed

400-mL beakers
glass stirring rod
funnel
filter paper
forceps or tongs
beaker tongs
alum, (aluminum potassium sulfate), $\text{KAl}(\text{SO}_4)_2 \cdot 12 \text{H}_2\text{O}$
cream of tartar (potassium bitartrate), $\text{KHC}_2\text{H}_4\text{O}_6$
iron(II) sulfate (ferrous sulfate), $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
tin(II) chloride (stannous chloride), SnCl_2
potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$
Suggested plant material: onion skins (red or yellow); marigold flowers; snapdragons; zinnia; tomato vines;
coffee and tea
2 x 5 cm strips of cotton, wool, and silk

Procedure

You will be preparing **5 sets of dyed cloth** using mordants for four of the sets.

While you are preparing your dye bath, also prepare your cloth samples for dyeing.

Preparation of the dye bath

Add enough plant material to a 400-mL beaker to cover the bottom, (at least 10 g). Add 50 mL of distilled or deionized water (or enough to cover the plant material).

Heat the mixture to boiling and boil it for about 20 minutes. Occasionally add distilled water to replace any water that boiled away.

Filter the hot solution and discard any plant material left in the filter paper.

Dilute the filtered solution with distilled water to 200 mL.

Preparing the cloth for dyeing

1. No mordant

Soak 1 strip each of cotton, wool, and silk with distilled water. Squeeze out the excess water. These samples are ready for dyeing

2. Alum-Potassium bitartrate mordant:

Weigh out 0.3 grams of alum (aluminum potassium sulfate) and add to a 400-mL beaker. Weigh out 0.1 gram of potassium bitartrate and combine it with the alum. Add 100 mL of distilled water to the beaker.

Add 1 strip each of cotton, wool, and silk to the solution and heat to boiling. Remove the solution from the heat and let stand for 5 minutes.

Remove the cloth strips and press the excess solution from it. The cloth is now ready for dyeing.

3. Iron(II) sulfate mordant

Repeat procedure 2, above, using 0.2 grams of iron(II) sulfate in 100 mL of distilled water.

4. Tin(II) chloride mordant

Repeat procedure 2, above, using 0.2 grams of tin(II) chloride in 100 mL of distilled water.

5. Potassium dichromate mordant

Repeat procedure 2, above, using 0.2 grams of potassium dichromate in 100 mL of distilled water.

Dyeing the Cloth

Heat the dye bath to boiling and lower the heat to maintain it at a simmer.

Sample set 1.

Add the three strips of cloth that were wetted with the distilled water. Continue to simmer for 5 to 10 minutes.

Remove the cloth strips from the dye bath and rinse them in a beaker of hot distilled water. Then repeat the rinse in a beaker of room temperature distilled water, continue to rinse until no more color is coming from the material.

Sample set 2.

Add the three strips of material that were treated with the alum-cream of tartar mordant and continue to simmer for 5 to 10 minutes.

Remove the cloth strips from the dye bath and rinse them in a beaker of hot distilled water. Then repeat the rinse in a beaker of room temperature distilled water, continue to rinse until no more color is coming from the material.

Label the cloth immediately with name of plant material used and the mordant.

Sample set 3.

Repeat the dyeing process using the same dye bath and the material treated with the iron(II) sulfate.

Sample set 4.

Repeat the dyeing process using the same dye bath and the material treated with the tin(II) chloride.

Sample set 5.

Repeat the dyeing process using the same dye bath and the material treated with the potassium dichromate.

For your laboratory report, compare the colors obtained with the different mordants and materials.

References

Natural Plant Dyeing, A Handbook, Brooklyn Botanic Garden, Brooklyn, N.Y. (May be out of print. Contact Brooklyn Botanic Garden, 1000 Washington Ave., Brooklyn, N.Y. 11225, or www.bbg.org on the Internet)

Natural Dyes: Plants and Processes, Jack Kramer, Charles Scribner's Sons, New York, N.Y., 1972

If you are interested in trying some natural dyeing at home, consult the above books or check your local library or book store. Also check online at www.amazon.com or www.barnesandnoble.com

NATURAL PLANT DYES

Report Form

Name _____ Course/Section _____

Partner(s) _____ Date _____

Results

Plant material used _____

Color of dye bath _____

Material:	wool	cotton	silk
Mordant			
None (cloth moistened with water)			
Alum			
iron(II) sulfate			
tin(II) chloride			
potassium dichromate			

ATTACH SAMPLES OF DYED CLOTH (properly labeled)