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Rubia tinctorum L. (Rubiaceae) or Madder as one of the living color to dyeing wool

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ABSTRACT

The medicinal part of *Rubia tinctorum* is the dried root. The small yellowishgreen flowers are in loose, leafy, long-peduncled terminal or auxiliary cymes. The margin of the calyx is indistinct, 4- to 5-sectioned and has a tip that is curved inward. There are five stamens and an inferior ovary. The fruit is a black, pea-sized glabrous, smooth drupe containing two seeds. The perennial plant grows to a height of 60 to 100 cm. The pencil thick rhizome creeps widely underground. The stem is quadrangular with backward turning prickles at the edges.

Key words: Rubia tinctorum, Madder, dyeing wool, red color

INTRODUCTION

The stems are at times so thin that they are more descendent than erect. The leaves are in whorls, in fours below, in sixes above. They are oblong to lanceolate with one rib and protrudingly reticulate beneath. The plant is indigenous to southern Europe, western Asia and North Africa, and is cultivated elsewhere (Medical Economics Co., 2000). Shape of madder showed in figure1.

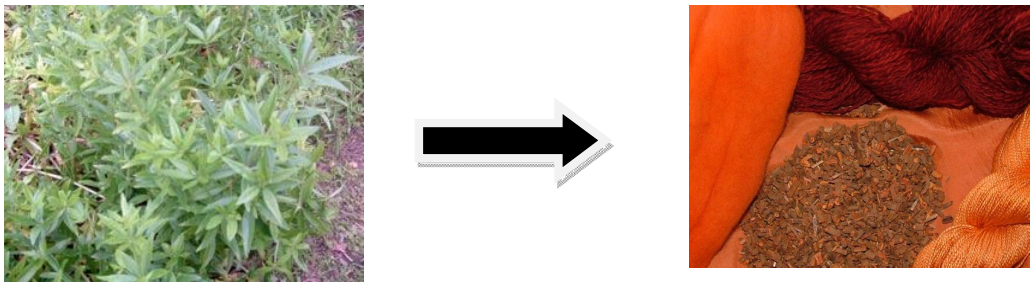

Figure 1: madder plant use to provide red colors

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Chemical constituents

Compounds found in Rubia tinctorum include purpurin (oxyalizarin; 1,2,4-trihydroxyanthraquinone), mollugin (6-hydroxy-2,2-dimethyl-2H-naphtho[1,2-b]pyran-5- carboxylic acid, methyl ester), 1-hydroxy-2-methylanthraquinone, 2-ethoxymethylanthraquinone, rubiadin (1,3-dihydroxy-2-methylanthraquinone), 1,3-dihydroxyanthraquinone, 7- hydroxy-2-methylanthraquinone, lucidin(1,3-dihydroxy-2hydroxymethylanthraquinone), 1- methoxymethylanthraquinone, 2,6-dihydroxyanthraquinone, lucidin3-o-primeveroside[6-(β-d-xylosido)-d-glucoside], alizarin(1,2-dihydroxyanthraquinone), lucidin-O-ethyl ether, 1-hydroxy-2-hydroxymethylanthraquinone 3-glucoside, 2-hydroxymethylanthraquinone 3-glucoside, 3,8-dihydroxy-2-hydroxymethylanthraquinone3-glucoside, ruberythric acid (alizarin primeveroside; alizarin glycoside), quinizarin and iridoid asperuloside (Schneider et al., 1979; Kawasaki et al., 1992; Derksen et al., 1998; El-Emary & Backheet, 1998; Marczylo et al., 2000). A number of compounds have been characterized from the roots of R. tinctorum (the source of commercial madder colour) by various analytical methods. Among these compounds are alizarin, ruberythric acid, purpurin, lucidin, rubiadin, mollugin, 1-hydroxy-2- methylanthraquinone, tectoquinone (2-methylanthraquinone), nordamnacanthal (1,3-dihydroxy-2-anthraquinonecarboxaldehyde),1-hydroxy-2methoxyanthraquinone, 1,3-dihydroxy-2-ethoxymethylanthraquinone, scopoletin (7-hydroxy-6-methoxycoumarin) and the glucosides and/or the primeverosides of these compounds (Kawasaki et al., 1992; Westendorf et al., 1998; Medical Economics Co., 2000). The majority of the anthraquinones present in the plant itself or in plant extracts are glycosides (Blömeke et al., 1992; Westendorf et al., 1998).

Use

The roots of R. tinctorum contain a red coloring matter which is used for dyeing. Additionally, extracts from R. tinctorum are used for the treatment of kidney and bladder stones (Westendorf et al., 1990; Blömeke et al., 1992). Plants containing 1-hydroxyanthraquinone have been widely used for pharmaceutical purposes such as treatment of kidney and bladder stones, as a laxative mixture, and as a mild sedative (Brown & Brown, 1976; Mori et al., 1990; Wang et al., 1992). Madder root has reportedly also been used medicinally for menstrual and urinary disorders (Medical Economics Co., 1998, 2000). The roots of M. officinalis have been used as a Chinese natural medicine for tonic and analgesic purposes. Anthraquinone glycosides are the active principles of plant-derived laxatives such as senna, cascara, frangula, rhubarb and aloe. These five plant-derived laxative substances are not included in the present review, because there are no published reports on their potential carcinogenicity. 1,8-Dihydroxyanthraquinone, the aglycone moiety of the laxative ingredient of senna, was formerly marketed as a laxative under the trade name Dantron®, but human drug products containing Dantron® (see IARC, 1990) were withdrawn from commerce in the United States in 1987 after it was shown to cause intestinal tumors in experimental animals.

Steps of coloring with natural coloring

For a long time now she has been niggled by the generally accepted stories about steaming dye vats. Unimpressed by rug lore, it seemed to her most unlikely that primitive tribes people would have resorted to such processes. If her feelings were reasonable, then it had to follow that it must be possible to achieve satisfactory results with water at "domestic" temperature. The countries in which rugs are traditionally made have a very warm climate, so a vat left out in the sun would certainly become pretty hot. Admittedly the process would be slower, but time was never a critical matter for primitive peoples who, in any case, were generally limited to measuring this in days and in lunar months. so variety of providing colors shown in figure 2.

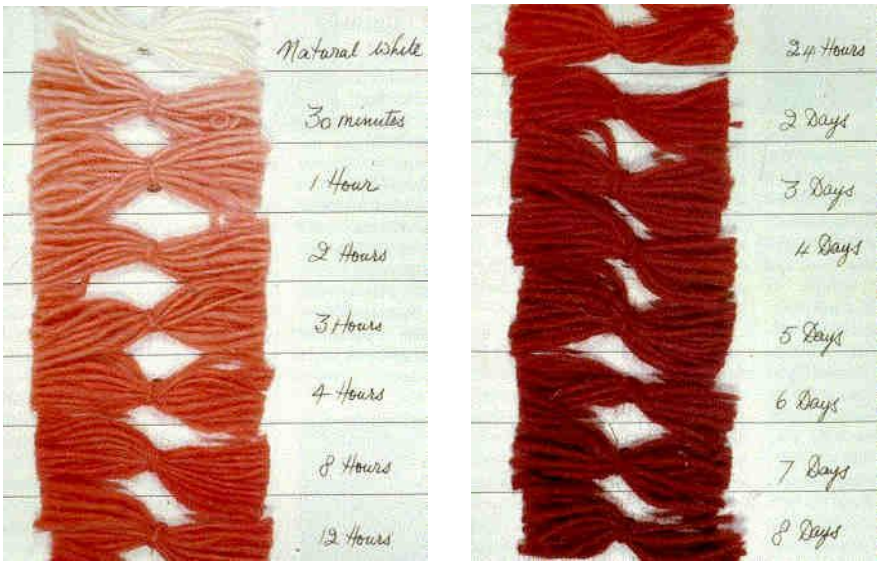


Figure 2. Providing colors after different steps of dyeing

With this in mind, she experimented with various mordant strengths, various concentrations of dye stuff, various periods of immersion, and various temperatures. Using madder in this way she achieved an incredible range of colors from the softest "decorator" pinks to the deep masculine reds so often found in Turcoman rugs. But her delight arose from the fact that her results could be consistently replicated. Thanks to modern photography and an excellent PC with a DTP program, she has crystallized these into picture and print as you can see. She has provided me with a recipe for cool dyeing with madder root, a card showing the deepening color in 15 individual swatches of natural white wool immersed for increasing periods from half an hour to eight days, and a color photograph showing the consequences of heat to swatches immersed for four different periods of time and at three different temperatures. Published treatises on dyeing with madder root have all warned the reader of the complexity and critical nature of the process, requiring the wool to be heated to temperatures likely to cause it to felt. The purpose of this experiment is to discover if it is possible to dye wool to deep brown-red shades without heating the dye pot to temperatures detrimental to the fiber.

Experiment 1

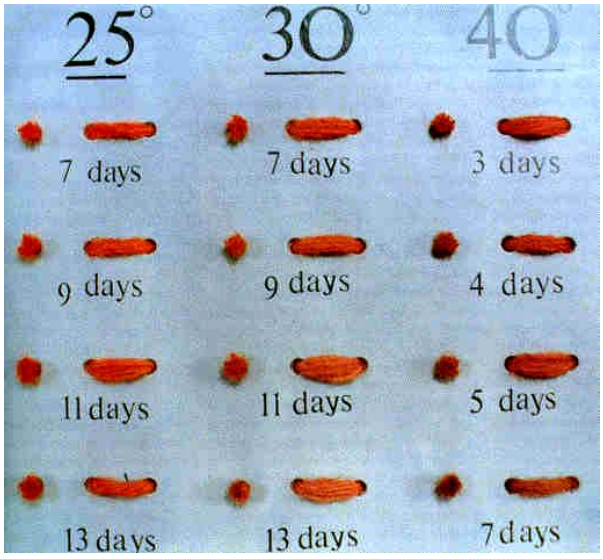
Wool was placed in a cold hard water bath containing Alum mordant in the proportion of 25% Alum to wool by weight and left to soak for 30 days. After removal from the vessel, the wool was rinsed in cold water.

The wool was then placed in a vessel with an equal weight of chopped madder root and water to cover. The vessel was brought up to a temperature of 40 degrees centigrade in this case by simply placing the vessel on the back of an Aga between the hot plates and further insulating the vessel with the appropriate number of pot holders underneath. Samples of wool were taken from the dye pot on the third, fourth, fifth, and seventh days. The results are shown in

Experiments 2 and 3

If it is possible to achieve such intensity of color within seven days at a temperature of 40 degrees, I was curious to know just how successful it would be at colder temperatures. Two vessels were prepared, the first at 30 degrees centigrade, a temperature which can be maintained by placing the pot near a radiator, for example. The other pot was left a room temperature, which was a constant 25 degrees centigrade. The results of these experiments show that given enough time, very intense shades of red and red-brown are achievable without any effort or skill involved in the process. The time comparison to
achieve a similar shade:

3 days at 40 degrees
9 days at 30 degrees
13 days at 25 degrees



Recipe for provide red color from madder

- ¼ lb. alum to 1 lb. wool

Place in cold water to cover for 30 days with an occasional prod.
Rinse well and spin.

- 1 lb. madder root to 1 lb. wool

Place in cold water to cover.
Heat to 40 degrees centigrade and maintain with occasional stir for required time and color intensity.

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