SUPPLEMENTARY MATERIAL

Dyeing wool and cotton fibres with acidic extract of *Hibiscus rosa sinensis* flower

Lamya Hayat*and Dangly Ann Jacob

Department of Biological Sciences, Faculty of Science, Kuwait University, State of Kuwait

*Corresponding author Email : Lamya14@hotmail.com

Abstract

The focus of this work is to extract a natural dye for coloring camel wool as a substitute for synthetic dyes used in the Sadu House of Kuwait. Their target is to keep the tradition of tent and rug production natural in all its manifestations. Therefore our task was to find an abundant source that provide a color preferably red to purple. *Hibiscus rosa sinensis* (HRS) is an abundantly available plant in Kuwait that was explored for extraction of the red dye to color camel wool permanently. The powdered petals of red flowers of HRS was extracted with 5% acetic acid which yielded a deep red color that showed a great potential for woolen fiber dying. The use of mordants like alum and some metal salts manifested a wide range of fixed colors which intensified at 85°C. The colors produced had excellent fastness and was accepted by the Sadu House.

Keywords: Hibiscus flower; acetic acid extract; Sadu house; Stannous chloride anthocyanin complex; red/purple permanent color.

Experimental

Materials

Source of colorant and storage

Red *Hibiscus rosa sinensis* (HRS) flowers were collected locally, the pollen was removed and only the petals were shade dried. HRS specimen (Voucher number: L.H.277) is deposited in Kuwait University Herbarium (KTUH). The dry petals were powdered using Braun food processor and stored in an amber colored glass jar at room temperature.

Substrate and Chemicals

Cotton and camel wool fibers used in this work were supplied by Sadu House, Kuwait. Glacial acetic acid (BDH) and 5% acetic acid were used for extraction procedures. Different reagent grade mordants such as alum ($\text{KAl}(\text{SO}_4)_2$, Fluka, 57 mM), sodium carbonate (BDH, 17.65mM), stannous chloride (Fluka, 21.45mM), Cobalt chloride (BDH, 29.04 mM), Ferric chloride (BDH 19.27 mM), potassium dichromate (Fluka, 3.15mM), magnesium sulphate (Fluka, 24.77 mM) and nickel chloride (Fluka, 12.31 mM). The detergent powder (Tide) was used for washing.

Instruments

Scouring and mordanting of the fibers and the extraction of colorant was carried out using a magnetic stirrer equipped with heater (Thermo Nouva). Dyeing of fiber was done using a water bath. The absorption spectrum was recorded using a Cary 300-Bio UV Visible spectrophotometer (Varian, Australia). A 0.45 μm filter unit (Millex – HA, Millipore) was used for filtering the extracts. A freeze dryer (Labconco, USA) was used for drying the extract.

Methods

Extraction of colorant

Ten grams each of the HRS powder was extracted with 150 ml each of glacial acetic acid (GAA) and 5% acetic acid (AA) in two separate beakers at room temperature by stirring on magnetic stirrer for 24 h and filtered and freeze dried to calculate the yield.

Scouring

Cotton and camel wool fiber (25 ± 0.02 mg each) were soaked in a solution prepared from (500 mg/L) sodium carbonate and detergent 2g/L at 45°C for 30 minutes. After removing them from the soak solution, washed the fiber with tap water, then air dried and stored in dark until use.

Premordanting treatment

The **scoured** fibers were treated with variable metal salt concentrations to obtain fixed color of the flower extract. Each gram of fibers were incubated with 50mL of heated mordanting solutions (85°C) for 1 hr and left in the mordant at room temperature for 24 hours followed by air drying the fiber under shade.

Dyeing

Each gram of the premordanted fibers (cotton & wool) were soaked in 4mL of the filtrate of step 1a and 1b in two containers. One container was heated at 85°C using thermostatic water bath for 2 hours and left at room temperature for 24 hours. The second container was incubated at room temperature for 24 hours.

Washing after dyeing

The dyed fiber was washed with strong detergent. It was rinsed with tap water until the washings were colorless and the absorbance spectrum of each wash solution was recorded using a UV Visible spectrophotometer. The fibers were sun dried and mounted on labeled paper for display and pictured for color identification under direct sunlight.

Washing after Sun exposure

After rinsing and drying the colored fibers they were exposed to the sunlight for 30 days. For proving the color fastness the dyed camel wool fiber were washed on regular intervals and measured the absorbance of each wash.

HRS extract absorption measurement

One gram of powdered HRS flowers was extracted with 15mL of 5% AA and ethanol. The extract was syringe filtered (0.45 μ m) and absorption was measured. The results are illustrated in Fig S1 and Fig S2.

List of Figures and tables in supplementary material

1. Figure S1. Absorption spectra of (HRS) flower extract in 5% AA.
2. Figure S2. Absorption spectra of (HRS) flower extract in ethanol.
3. Figure S3. Absorption spectra of 5%AA extract of HRS and SnCl₂ solution.
4. Table S1. Absorbance of the colored fiber washes exposed to sunlight for 30 days

Figure S1. Absorption spectra of (HRS) flower extract in 5% AA.

Figure S2. Absorption spectra of (HRS) flower extract in ethanol.

Figure S3. Absorption spectra of 5%AA extract of HRS and SnCl₂ solution.

Table S1. Absorbance of the colored fiber washes exposed to sunlight for 30 days

Sunlight exposure (days)	Absorbance value of colored fibers wash at $\lambda=556$ nm
0	0.062
9	0.034
16	0.032
23	0.030
30	0.000