

## ABSTRACT

Natural dyes are prominent possessions of natural wealth. They are obtained from the natural sources like plants, minerals, and insects (excreta). These dyes are mostly environmentally friendly and their production and composition will help in maintaining the ecological balance, since these dyes are biodegradable. These dyes are considered to be non-toxic and health hazards like allergies could be avoided. They are aesthetically appealing too. Until the late nineteenth century these were the only dyes used for coloring textile yarns.

Most of the natural dyes are only sparingly soluble in water due to the absence of solubilising groups. Additional after treatments such as post mordanting with ferrous salt or black tanning often helps to improve the fastness of natural dyes by insolubilising the dye inside the fiber. There are three major types of natural dyes such as a) substantive dyes which require no mordants, b) vat dyes and c) mordant dyes which require auxiliary substances to attach the dyes to the fiber. Natural dyes can be broadly sorted into three categories: natural dyes obtained from plants (indigo), those obtained from animals (cochineal), and those obtained from minerals (ocher).

A mordant is an element which aids the chemical reaction that takes place between the dye and the fiber indirectly so that the dye is fixed on the textiles. Containers used for dyeing must be non-reactive (enamel, stainless

steel). Brass, copper and iron pots will do their own mordanting, hence should not be used directly. Not all dyes need mordants to help them adhere to fabric. Dyes such as lichens and walnut hulls are called substantive dyes because they do not require mordants. The dyes that require mordants are called adjective dyes. Common mordants are alum usually applied with cream of tartar, which helps evenness and brightens; iron or copperas which darkens colors bringing out green shades; tin usually used with cream of tartar which blooms or brightens colors, especially of reds, oranges and yellows.

Textile fabrics such as Cotton, Silk and Wool with the following specifications were used. Cotton: 1/1 plain weave, 60/50 ends and picks per inch, 60s count, desized, scoured and bleached. Silk: 1/1 plain weave, 80/70 ends and picks per inch, 90s count, degummed. Wool: 1/2 twill weave, 40/40 ends and picks per inch, 50s count, desized, scoured and bleached.

The main raw natural sources used for the study were berberis vulgaris (Bv), bixaorellana (Bo), terminalia chebula (Tc), punica granatum (Pg), allium cepa (Al) and citrus paradisi (Cp). The supporting sources used for the combination to bring the shade variation are indigofera tinctoria (If), rubia cardifolia (Rc) and pterocarpus santallinus (Pp). The natural sources added to bring the functional property were vitex negundo (Vn), emblica officinalis (Eo), aloe barbadensis (Ab) and azadirachta indica (Ai).

Natural dye solutions of major dye ingredients berberis vulgaris (Bv), bixaorellana (Bo), terminalia chebula (Tc), punica granatum (Pg), allium cepa (Al) and citrus paradisi (Cp); and supporting dyes indigofera tinctoria,

rubia cardifolia, pterocarpus santallinus; and the added natural sources such as vitex negundo, emblica officinalis, aloe barbadensis and azadirachta indica were extracted by aqueous method as per the established technique.

The extracted dye solutions from the natural dye sources were applied on pre-treated cotton, silk and wool fabrics. The dyeing temperature of all these dyes with respect to the textile fabrics (cotton, silk and wool) was fixed in the range of 45°C-90°C, depending upon the dye characteristics. The dyeing assistants sodium chloride, sodium carbonate and potash alum were applied in accordance with the trials made for pre, post and simultaneous mordanting techniques suitable for good results. The concentration of the natural dye is fixed based on the textile material weight and varied between lighter to darker shade with respect to dye character. The concentration of the dyeing assistants was set to the maximum as 2.5% (over the weight of the material) for better dyeing effect and accordingly material liquor ratio was maintained as 1:20.

Based on the results obtained from the studies, the following conclusions are arrived.

The average fastness properties (light, wash and crocking) of the natural dyes (Bv, Bo, Tc, Pg, Al and Cp) and their combinations applied on cotton, silk and wool fabrics are between 3 and 3-4. The achieved fastness property ratings were considered as moderate to good. The average color strength of all the natural dyed samples exhibited by K/S value is good. The antimicrobial property of natural dyes and their combination applied on textile

fabrics (cotton, silk and wool) is good revealed by the bacterial count reduction percentage. In general, the reduction percentage of microbial colonies was found good in gram+ culture (S.aureus) than gram- culture (E.coli) in all the dyed samples. The chemical group of natural dyes analyzed from the peaks obtained from FTIR was found that the extracted dyes contained the essential reactive groups responsible for a dye compound, to react with the textile fabrics.

Based on these considerations, as these natural dyes give good colors on textile fabrics with required color strength, fastness properties and functional considerations, they would be suitable as responsible natural dyes by providing the major requirements needed for the textile processing industries, including garment and apparel units.