

EXECUTIVE SUMMARY OF
UGC MAJOR RESEARCH PROJECT

**“Analysis of chemical mordants and bio-mordants
applied on fabric using a natural dye extracted from
“*Sesbania aculeata*” plant”**



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A conceptual foundation of physical, biological and chemical properties of *Sesbania aculeata* plant was carried out. After dyeing leaves to extract the dye from *Sesbania aculeata* plant aqueous method was adopted. The major colouring pigments present in the extracted dyestuff were then identified with the help of Ultra- violet, visible and IR graphs. The extracted dye was applied on cotton and silk fabric using five different bio mordants and five chemical mordants. Three mordanting methods were adopted during dyeing. The optimum dyeing parameters like M: L ratio, dye extraction time, extraction temperature, dyeing time and dyeing temperature were derived. The fastness properties of dyed fabrics were tested and the colour measurements like K/S values, CIE L*a*b values of the dyed fabric were measured.

Sesbania is a genus of flowering plants in the pea family, "Fabaceae". The name 'Fabaceae' comes from the genus *Faba* also be known as Leguminosae. *Sesbania aculeata* is an erect low annual subshrub, which usually reaches one to two meters in height. The leaves are oblong, linear and pinnately compound having a glabrous surface. Its seed produced pods which contain light brown beans. The stems of the plant are fibrous, thick and pithy with long leaves and branches from the base. The plant bears yellow flowers. The growth pattern showed that the crop takes about 12-13 weeks to acquiring complete grow. The present study revealed that the yield per hectare for *Sesbania aculeata* is 625kg. From the dried leaves the dye was extracted using aqueous method. Different bio mordants and chemical mordants in various combinations and concentrations were applied during pre- mordanting, simultaneous- mordanting and post- mordanting the cotton & silk fabric. The shades achieved suggested that silk fabric gave better absorption and a wide range of shades when compared with cotton while dyeing with the aqueous extract of *Sesbania aculeata* plant.

After the successful extraction of the dye from the plant, for dyeing certain optimizations were done. The key parameters that were optimized were dye material weight as 10gm/100ml. and mass liquor ratio as 1:40. The extraction time and dyeing temperature was optimized at 3 hour and 70° C and the dyeing time for both fabrics was 3 hours (table-1). The combination of these setting provided best dyeing results. The dyed sample were tested for wash, light and rubbing fastness and the colour measurements such as K/S values, CIE L*a*b* values were measured. Dyeing process resulted in different shades on cotton and silk with the extract. The shades achieved had are described in table-2

Parameters	Optimised level	
	Bio-mordants	Chemical-mordants
Dye material weight	10.0gm	10gm/100ml
Mass to liquor ratio	1:40ml	1:40ml
Dyeing extraction time	3 hour	3 hour
Dyeing time	3.0 hours	3.0 hours
Dyeing temperature	65° C	70° C
Mordanting time	50minutes	50 minutes
Concentration of Mordant	10%	1% potassium dichromate 2% other chemicals 4% alum

Table- 1 optimized parameters of dyeing with *Sesbania aculeata*

Fabrics	Shades obtained using bio mordants	Shades obtained using chemical mordants
Cotton	Light to dark shades of brown.	Light shades of green to yellow
Silk	Brown to golden yellow, beige	Dark brown, rusty green, green and golden yellow

Table- 2 Shades achieved on the dyed fabrics

After dyeing cotton and silk with aqueous extract of *Sesbania aculeata*, the fastness of the dyed fabrics was carried out. Wash fastness, rubbing fastness (dry and wet) and light fastness properties were tested as per AATCC test procedures and standards.

In dyed cotton wash fastness was found to range between average to good and on dyed silk fabric good to very good wash fastness was observed with all mordants. The dry rubbing fastness was better than the wet rubbing fastness on both dyed fabrics. Light fastness was moderately fair in both fabrics. The study revealed that the pre and simultaneous mordanted samples had better fastness properties when compared to post mordanting method. The colour measurements through K/S values and CIE L*a*b* values with pre mordanted technique showed that the K/S values of the sample mordanted with tea leave was highest amongst bio mordants

(10.363) when compared with the unmordanted control sample with K/S value of 2.64. Similarly ferrous sulphate had highest K/S value 2.65 when compared with unmordanted control cotton fabric. The lowest absorption and scattering values were found on dyed cotton & silk fabrics which were mordanted with gooseberry, myrobalan, alum and stannous. The a^* b^* values were positive, imparting tone of slight red to yellow; some values were negative too suggesting green to blue shades. The depth and brightness in the samples was assessed by the evident considerably high L^* values.

In case of simultaneous mordanted samples, the K/S values were higher than the pre or post mordanted samples with myrobalan, tea leaves, copper sulphate and ferrous sulphate on both cotton and silk fabrics. The L^* values were low for copper sulphate and ferrous sulphate (66 to 72) and shade became dull and dark when simultaneous mordanting technique was adopted.

The post mordanted samples of cotton and silk dyed with aqueous extract showed shades with relatively low values of the a^* indicating, less bright and dull shades on both fabrics with the other two mordanting methods. In case of the control/unmordanted sample a low K/S value in comparison of post mordanted samples was observed. Thus it is evident that pre and simultaneous mordanting method gave better shades than the post mordanted dyed cotton and silk fabric pieces.

MAJOR FINDINGS-

- The *Sesbania aculeata* plant is easy to cultivate and maintain. It has a high yield per hectare and thus can be a cheap source of natural dye.
- The extract obtained through the aqueous extraction of *Sesbania aculeata* plant gives rusty green colour.
- The study signifies that the extract of *Sesbania aculeata* has chlorophyll, Flavonoids and polyphenols.
- Parameters for optimization for dyeing samples with *Sesbania aculeata* plant were –
 - 10g/100 ml dye material concentration.
 - 1:40 M: L ratio, 3 hours of dye extraction at optimum temperature of 70°C.
 - Dyeing time of 3 hours at 70°C.
 - Mordanting time of 50 minutes.
- *Sesbania aculeata* after pre, simultaneous and post treatment with different mordants like alum, copper sulphate, ferrous sulphate, potassium dichromate and stannous chloride imparts shades which varied from dark brown to light golden yellow on cotton or silk fabric.
- The best shades are obtained in the order of relatively with different mordants with simultaneous mordanting method > pre-mordanting method > post mordanting

methods. Since the simultaneous –mordanting and pre mordanting method resulted in higher dye affinity. It was also observed that much varied shades were obtained with aqueous extract.

- Dark and bright shades are obtained in case of pre and simultaneous-mordanting dyeing with *Sesbaniaaculeata*. In case of post-mordanting method, the mordant does not have enough chance to act upon the fabric.
- Usually tans and dark shades were obtained through sulphates. Chlorides, alum, gooseberry myrobalan gave light of beige and their tints. Sulphates, that is, ferrous sulphate, copper sulphate and tea levees gave the darkest range of brown and green on cotton and silk fabrics.
- The different mordants used not only changed the hue and colour achieved and significant changes in K/S values and the brightness index values were found.
- The wash fastness was found to vary from good to excellent. The dry rubbing fastness was better than wet rubbing fastness. The light fastness was moderately fair. In general, the simultaneous-mordanted samples had better fastness properties as compared to other mordanting methods.
- The dye uptake value increased as the time increases.
- This dye acquired from aqueous extract of *Sesbania aculeata* can be used safely on cotton and silk giving varied ranges of colour with good to excellent fastness properties.

13. CONTRIBUTION TO THE SOCIETY-

- The plant *Sesbania Aculeata* is a weed crop which can easily be grown by farmers in their field. For its growth lot of water is not desired and it is a fast growing crop. Total yield of *Sesbania Aculeata* is 6.25kg per hectare which appears to be a lucrative crop for farmers.
- The leaves can be acquired in about 2 month's duration after sowing and are worth processing.
- Silk fiber can be dyed in variety of shade with these leaves using bio-mordants and chemical mordants to acquire the beautiful ranges of olive green to browns.
- The utilization of the leaves of *Sesbania Aculeata* as a dye is thus a contribution of present study for the society.