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APPLICATION OF KALANCHOE-PINNATA AND SIDA-CORDIFOLIA HERBS IN COLOURATION OF TEXTILES

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KEYWORDS: Kalanchoe-Pinnata, Sida-Cordifolia, Dye extraction, chemical and natural mordants, Dyeing of wool and silk.

ABSTRACT

Since Vedic era herbs and medicinal plants have been widely used in healing various ailments of human beings and animals' health care. These herbs are widely used in pharmacological industries as life saving drug due to their suitable chemical composition. These herbs can cure disease problems and provide fresh and healthy life. Kalanchoe-pinnata and sida-cordifolia are also such type of herbs found in tropical and subtropical places. These herbs have already been used extensively in ayurveda but their potential in textile colouration and finishing is still unexplored. These aforesaid properties tempted us to investigate colouration behavior of both these herbs on cotton and woollen textile materials. The present paper introduces the kalanchoe-pinnata and sida-cordifolia herbs, their medicinal properties along with dyeing behaviors in brief.

INTRODUCTION

Natural dyes are known in India and across the globe since prehistoric time. Synthetic dyes replaced most of the natural dyes due to their mass production at low cost with excellent shades, leveling and fastness properties. Although natural dyes are getting importance due to their biodegradability and eco-friendly nature. Now approximately 10,000 of synthetic dyes [1] of more than 7 million tons are produced annually and out of which approximately 200,000 tons dyes lost in effluent during textile wet processing [2]. Beside these various auxiliaries in printing and finishing also pollute the environment. The non-biodegradable toxic synthetic dyes in effluent are damaging the aquatic life tremendously and causing various environmental and human health hazards. Due to limited land resources, it is not possible to replace toxic synthetic dyes with cultivating more natural dyes by replacing the food crops. Only about 1 % of the total textiles produced are dyed by using natural dyes [3]. To increase the market share of natural dyes consumer awareness should be created about the harms of synthetic dyes and benefits of natural dyes. Although there are great potential for natural dyes, which are obtained as byproducts or as waste from agro products i.e. Pomegranate rind, onion peel off, certain barks, leaves, flowers, etc. Flowers waste from temple can also offer an inexpensive source of natural dyes [5]. Beside these, few natural dyes are being used in textile due to their medicinal properties. "In India during 1998–2001 UNDP-sponsored a project which listed more than 100 promising natural dye materials" [4]. Kalanchoe-pinnata and sida-cordifolia are such type of well known ayurvedic herbs. As per the literature available these herbs have excellent medicinal properties but there were no available literature on their colouration behaviour. Here it is a small effort to explore herbal properties of kalanchoe-pinnata and sida-cordifolia as well as their behavior on textile colouration. The foregoing section of this paper introducing the kalanchoe-pinnata and sida-cordifolia herbs with their nomenclature, medicinal properties along with their textile colouration and fastness behavior on cotton and wool. The natural dyeing was performed by using chemical as well as natural mordants.

Kalanchoe-Pinnata It is a perennial herb. It grows up to a height of about 12-65 inch tall with fleshy dark green leaves that are distinctively scalloped and trimmed in red and bell like pendulous flowers as shown in figure 1. These can be reproduced from seeds. Kalanchoe-pinnata is known as herbal medicine that having many special advantages. It is known by many names as shown in Table 1 in different areas of country and abroad [6, 7].



Figure1: Herb of Kalanchoe-Pinnata

Sida-Cordifolia It is commonly known as “Bala” in Hindi and Sanskrit. It is also known by other names as mentioned in Table 1. It grows as wasteland weed. In the leaves of sida-cordifolia ephedrine and pseudoephedrine are found. Ephedrine is known as a stimulator for the central nervous system (CNS) and act as a weight losing agent. Sida-cordifolia is a small, erect, downy shrub(Figure 2). Roots of the herb which constitute a drug are 5-15 cm long with few lateral roots of smaller size. The outer surface of the root is off to grayish yellow. It is mostly odorless with less bitter taste [8, 9].



Figure2: Herb of Sida-Cordifolia

Their chemical compositions are mentioned in Table 2 where as chemical structures are shown in Figure 3.

Table 1 Herbs Description of Kalanchoe-Pinnata and Sida-Cordifolia

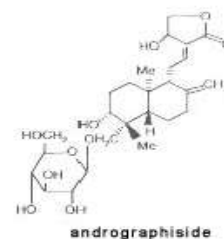
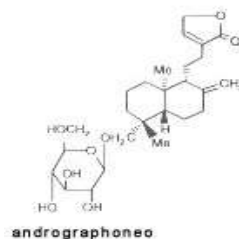
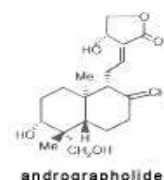
Herbs description	
Kalanchoe-Pinnata	Sida-Cordifolia
<ul style="list-style-type: none"> ➤ Botanical Name: - Bryophyllum pinnatum ➤ Family Name:- Crassulaceae ➤ Sanskrit Name: - Pashanabheda, parnbeej, hemsagar. ➤ Hindi Name:-Patharchur. ➤ Bengali:-koppat, patharkuchi. ➤ Telugu:- Ranapala ➤ Tamil:- Runa kalli <p>Other common Names: Cathedral Bells, Air Plant, Life Plant, Miracle Leaf, Goethe Plant and Katakataka. Also called “Wonder of the World” in the English speaking Caribbean. ‘OliwaKaKahakai (Hawai’i), Mother Of Thousands, Herbe Mal Tete (Dominica) Never Dead, Parvu, Hoja Del Aire (Bolivia).[6,10,11]</p>	<ul style="list-style-type: none"> ➤ Botanical Name: -S.cordifolia ➤ Hindi - Kungyi ➤ English - Country mallow ➤ Sanskrit – Bala ➤ inhala:bala,babila. ➤ Tamil - Mayir-manikhham,thuththi. ➤ Bengali - Brela ➤ Gujarati - Junglimethi ➤ Malayalam - Velluram ➤ Punjab - Simak ➤ maharastra – Chikana ➤ Kannada-hetthuti-gida[8,13,14] <p>Other Names:- Bariar, Batyalaka, Beejband, Bijband, Brela, Chikana, Chiribenda, Chitimutti, Hettuti-gida, Janglimethi, Kharenti, Khareti, Kisangi, Kungyi, Mayir-manikhham, Muttuva, Paniyar-tutti, Simak, Tupkaria, Tutturabenda and Velluram.[8]</p>

Table 2 Chemical Composition and Structure of Kalanchoe-Pinnata and Sida-Cordifolia

Kalanchoe-Pinnata	Sida-Cordifolia	
<ul style="list-style-type: none"> ➤ Alkaloids ➤ Triterpenes, ➤ Glycosides, ➤ Flavonoids, ➤ Cardenolides, ➤ Steroids, ➤ Bufadienolides and lipids [6,7,9,] 	<ul style="list-style-type: none"> ➤ Ephedrine. ➤ Pseudoephedrine ➤ Sterculic, ➤ malvalic ➤ coronaric acid. ➤ Fatty acids. ➤ Saponine. ➤ Betaphenethylami ➤ Volatile oils ➤ Fixed oil and fats ➤ Steroids ➤ Glycosides ➤ Triterpenoids ➤ Cardiac glycoside 	<ul style="list-style-type: none"> ➤ Hypaphorine. ➤ Ecdysterone ➤ Indole alkaloides. ➤ Palmitic, stearic and β – sitosterol. ➤ Alkaloids ➤ Carbohydrates ➤ Glycosides ➤ Tannins ➤ Phytosterols ➤ Proteins ➤ Flavonoids ➤ Lignin ➤ Aanthraquinone [8,10,12,13]



R₁= Rha, R₂= Rha: kaempferitin, 1
 R₁= Rha-OAc, R₂= Rha: kaempferol 3-O- α -L-(2-acetyl)chamnopyranoside-7-O- α -L-chamnopyranoside, 2
 R₁= Rha-OAc, R₂= Rha: kaempferol 3-O- α -L-(3-acetyl)chamnopyranoside-7-O- α -L-chamnopyranoside, 3
 R₁= Rha-OAc, R₂= Rha: kaempferol 3-O- α -L-(4-acetyl)chamnopyranoside-7-O- α -L-chamnopyranoside, 4
 R₁= Glc, R₂= Rha: kaempferol 3-O- α -D-glucopyranoside-7-O- α -L-chamnopyranoside, 5
 R₁= Rha, R₂= H: afzelin, 6
 R₁= H, R₂= Rha: α -chamisso robin, 7



Sida-Cordifolia [29]

Kalanchoe-Pinnata [30]

Figure 3 Chemical structure of Kalanchoe-Pinnata and Sida-Cordifolia

General Medicinal Usage of Kalanchoe-Pinnata and Sida-Cordifolia

The leaf powder of kalancho-epinnta herb with black pepper is useful in inflammation, burning in urination and blocked urination and leprosy. The leaves are useful in burns, stones, boils, bites of insects, congestive ophthalmia, dysentery, impetigo, polyuria, legman, swellings, tuberculosis, ulcers and acnes. The leaves roasted over fire are applied on wounds and surgical sutures in the skin to prevent discoloration and marks of the skin. The leaf juice mixed with black pepper is useful in blood oozing piles and hemorrhoids .The leaf juice 3-4 g, cumin seeds 3-4 g and ghee (vegetable oil) 5-6 g are mixed and given for blood mixed diarrhea. The leaf poultice is applied on wounds, sprains, swellings and inflammations. The leaf juice is also useful in cholera. Leaves and roots of sida-cordifolia herb are useful in fat loss and inflammation. This herb is also using for central nerves system depressant, wound healing activity, antimicrobial and anti-oxidant activity. The pharmaceutical activities of these herbs are tabulated in Table 3 [7, 8, 10, 11, 12, 15]

Table 3 Pharmacological Activities of Kalanchoe-Pinnata and Sida-Cordifolia

Kalanchoe-Pinnata		Sida-Cordifolia
➤ Herbal Tonic.	➤ Insecticidal.	➤ Central Nerves System depressant.
➤ Antileishmanial activity.	➤ Fungi toxic.	➤ Fat loss.
➤ Hepatoprotective and Nephroprotective.	➤ Phototoxic activity.	➤ Analgesic and anti-inflammatory.
➤ Neuropharmacological activities.	➤ Anticancer.	➤ Hypertensive.
➤ Anti-mutagenic activity.	➤ Anti bacterial.	➤ Hepatoprotective.
➤ Immunosuppressive effect.	➤ Anti oxidant.	➤ Anti microbial activity.
➤ Antihypertensive activity.	➤ Anti microbial.	➤ Adaptogenic activity.
➤ Analgesic.	➤ Anti diabetic.	➤ Anti Parkinson's disease.
➤ Anti-inflammatory.	➤ Anti ulcer.	➤ Wound healing activity.
➤ Wound Healing activity.	➤ Anti depressant.	➤ Anti hyper triglyceridemic activity.
➤ Uterine Contractility.	➤ Creatinekinase .	➤ Anti –oxidant activity [8,10,12]
➤ Toxic to cattle.	Neurosedative/muscle relaxant [6,7,9,]	

DETERMINATION OF HERB'S ROLE IN TEXTILES

It has been observed from cited literature that both the plants have good medicinal properties but no literature was found on the textile application such as in dyeing and finishing behavior. Therefore a preliminary work has been done on these herbs application on cotton and wool textiles to check their colouring behavior and finishing properties.

MATERIALS AND EXPERIMENTAL PROCEDURE

Natural dyes are extracted from the nature so cannot be applied directly to the fabric. Therefore extraction process is needed to extract the dye substrate from the source. Different extraction processes are to be followed for different sources of dyes to be extracted. Some of the extraction practices which are followed are aqueous extraction process, solvent extraction, supercritical fluid extraction, enzymatic extraction, alkali/acid extraction, microwave/ ultrasonic assisted extraction, fermentation extraction process, etc. In present investigation aqueous extraction process was employed for dye extraction i.e. boiling of herbs in water and using the residual supernatant liquor as colouring solution after the filtration. The textile substrates were dyed with these dye extracts as such or after the appropriate dilutions. Mordants play important role in dyeing with natural dyes as they bind the colour molecules to the fabric via forming complex with dye particle and textile substrate. Mostly traditionally used mordants like alum, ferrous sulphate, ammonium sulphate, copper sulphate etc are toxic in nature being heavy metals. Therefore emphases have been also given on natural mordants due to their eco-friendly nature. In present investigation of dyeing, natural herbs exhausted fabrics have been post mordanted by use of chemical as well as natural mordants.

EXPERIMENTAL PROCEDURE

Herbs Collection:-Kalanchoepinnataandsidacordifoliaboth were collected from B.P.S Mahila University, Sonapat, Haryana, India.

Parts Used: leaves and flowers of kalanchoepinnata and sida-cordifolia

Textile Material used for Dying: Pretreated or ready to dye cotton and wool fabrics.

Mordants:-

Chemical mordant's:-Alum, Copper sulphate, Ferrous sulphate of analytical reagent grade.

Natural mordant's: - Orange peel, Harda powderandGooseberry powder

EXTRACTION PROCEDUREFROMKALANCHOE PINNATAAANDSIDA CORDIFOLIAHERBS

The flow chart for the extraction procedure is shown as follows in figure4. Natural dyes were extracted from boiling of 100gm of leaves of herbsin 1litre water. When it was assured that appropriate extraction has been carried out in approximately 1 hrthen solution was filtered and maintained to 1litre. In similar way extraction of flowers was also carried out.Further, this dye extract (basically 10 % on the basis of initially taken herb in water for extraction) has been taken as such for dyeing purposed without drying or purification.

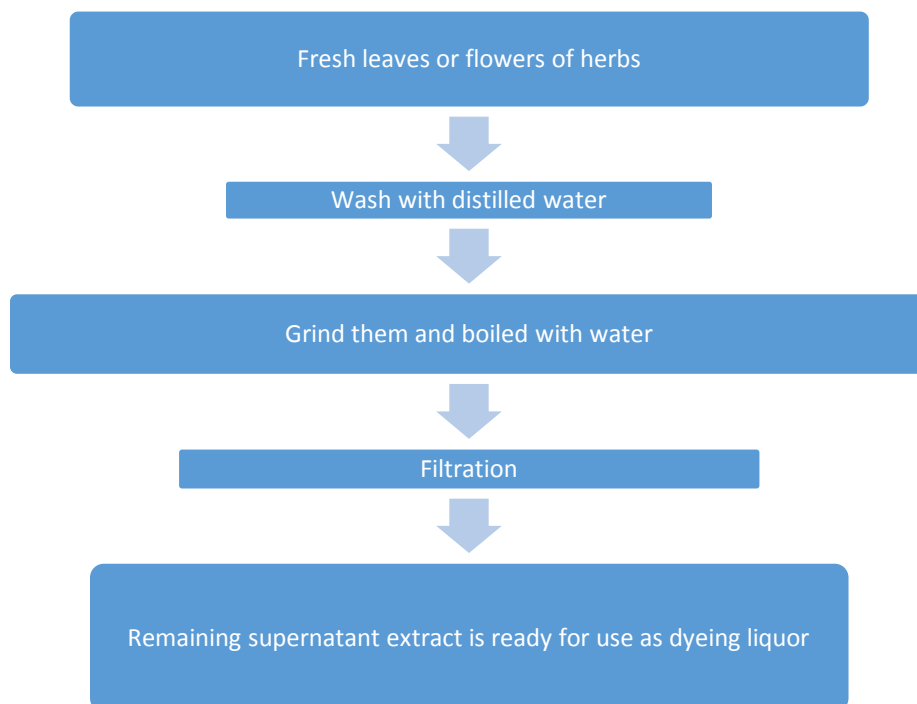


Fig 4 Extraction Procedure of Natural dyes from KalanchoePinnata and SidaCordifoliaHerbs. [17, 18, 19]


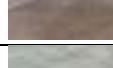

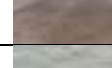
Dyeing procedure for Kalanchoepinnata and Sidacordifolia

Initially various trials have been carried out to optimize the various parameters of dyeing such as dye and mordant concentration, temperature, time, pH, etc. Further, the cotton and woolen textile materials have been dyed from following optimized dye recipe.

- Dye extract: 50% v/w owing weight of the fabric (OWF) in case of Kalanchoepinnata
30% v/w owing weight of the fabric (OWF) in case of Sidacordifolia
- Mordant Concentration: 15% w/w owing weight of the fabric (OWF) in case of chemical mordant
20% w/w owing weight of the fabric (OWF) in case of natural mordant
- Temperature: 90^o-100^oC
- Time: 60-75 minutes
- pH: 5.5-6.5
- MLR: 1:30

Both the fabrics were dyed using water shaker bath machine in conical flasks via meta-mordanting method of dyeing. The cotton and wool samples dyed with kalanchoepinnata and sidacordifolia with various mordants are shown in Table 5.

Table 5Shade Card of KalanchoePinnata and SidaCordifolia on Cotton and Wool Dyed Samples

KalanchoePinnata	Dyed samples of		SidaCordifolia	Dyed samples of	
	cotton	wool		Cotton	wool
Leaves, 50% with mordant and their conc.			Leaves, 30% with mordant and their conc.		
Without mordanting			Without mordanting		
Goose berry powder, 20%			Goose berry powder, 20%		
Harda powder, 20%			Harda powder, 20%		
Orange peel powder, 20%			Orange peel powder, 20%		
Copper sulphate, 15%			Copper sulphate, 15%		

Alum, 15%			Alum, 15%		
Ferrous sulphate, 15%			Ferrous sulphate, 15%		
Flowers, 50% with mordant and their conc.	cotton	wool	Flowers, 30% with mordant and their conc.	Cotton	wool
Without mordant			Without mordant		
Goose berry powder, 20%			Goose berry powder, 20%		
Harda powder, 20%			Harda powder, 20%		
Orange peel powder, 20%			Orange peel powder, 20%		
Copper sulphate, 15%			Copper sulphate, 15%		
Alum, 15%			Alum, 15%		
Ferrous sulphate, 15%			Ferrous sulphate, 15%		

The finding of the dyeing study is as follows:

- Both the herbs give good spectrum of shades to cotton as well as wool fabrics in metamordanting dyeing procedure.
- The leaves as well as flower of both of these herbs can be used for dyeing purpose.
- Both the natural herbs have lesser affinity for cotton than wool hence lighter shades were obtained on cotton.
- The natural mordants are found as effective as chemical mordants therefore they have great potential to replace toxic chemical based heavy metallic mordants.

CONCLUSION

This preliminary study shows that these natural herbs can be employed efficiently with chemical as well as natural mordants to cotton and woollentextile materials with excellent shades. Leaves and flowers of both these herbs have good affinity for woollen textile material whereas less affinity was obtained on cotton. Therefore there is a good scope of complete eco-friendly dyeing of woollen with renewable sustainable natural herbs and natural mordants. It is great hope that textile material accompanying the natural herbs will have great potential to be explored as medical textile material in future. Dyeing of cotton and wool can be also carried out with pre and post mordanting procedures, which is also under investigation. The determination of wash, light fastnesses, L a b colour values, etc. extensive work is under progress.

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