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A Green Approach to Dyeing Cotton and Fiber extracted from *Ananas comosus* (L.)Merr. by using dried and powdered Pods of *Cassia Fistula* L.

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Abstract

In this study, dyeing of cotton and fiber extracted from *Ananas cosmosus (*L.) Merr. using dried and powdered flowers of *Cassia fistula* Linn, was carried out. The dye extracted from the dried and powdered pod extract of *Cassia fistula* Linn. Dyeing of cotton and fiber without the use of mordant, pre-mordanting, simultaneous mordanting and post mordanting are carried out. The premordanting, simultaneous mordanting and post- mordannting was done with five selected mordants, such as Potassium dichromate, Ferrous sulphate, Copper sulphate, Tannic acid and a natural mordant extracted from *Anacardium occidentale* L.. These mordants give different colour shades to the fabric. The dyeing gave shades of brown, black, yellow, and red colours. Colour yield depends upon the type of mordant. The mordants such as Ferrous sulphate, Copper sulphate and Potassium dichromate give more colour intensity in cotton fabric and fiber than the mordants such as Tannic acid and natural mordant that is the pod extract of *Anacardium occidentale* L.
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1. Introduction

A dye can be defined asa highly coloured substance used to impart colour to an different varieties of materials like Paper, Varnishes, Leather, Food Stuff, Fabrics, Cosmetics, Medicines etc. Dyes are of two types – natural dyes and synthetic dyes. Natural cellulose fiber extracted from *Ananas comosus* (L.)Merr.(pineapple) leaves is comprehensively investigated as viable alternative for synthetic based fibers and which is non-degradable and toxic. *Ananas comosus* (L.) Merr. leaves fiber is extracted and investigated as reinforcement in polymer composite for engineering applications. The alkaline, bleaching and combined alkaline bleach treatments utilized in extraction ofthe cellulose fiber to evaluate the effect on the mechanical property. Natural fibers are lingo-cellulosic in nature that mainly composed of cellulose, hemicellulose and lignin (*Deoetal.,*1999). Natural dye sources are eco- friendly and permanent fabrics. Natural dyes should be increased to prevent us from pollution and other harmful effects. Natural dyes provide extra properties such as UV protection, Skin moisturizing and anti-ageing (Samanta *et al.,* 2011).

In India, it accounts for the largest consumption of dye stuff at 80%, taking in every type of dye and pigment produced. India is the second largest exporter of dye stuff, after China. Different regions of the world had their own natural dyeing traditions utilizing the natural resources available in that region. There are several factors which influence the content of the dye ineach dye yielding plant (Kulkarni *et al.,* 2011). Nearly all dye stuff is now produced from synthetic compounds. Natural dye produces very uncommon, soothing and soft shades as compared to synthetic dyes. On the other hand, many commercial practitioners feel that natural dyes are nonviable on grounds of both quality and economics. Some synthetic

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dyes are too toxic, when inhaled, absorbed through the skin or ingested (Satyanarayanan *et al*., 2013).

Natural colors are easier to metabolize than synthetic counter parts. Safflower, *Caesalpinia*, Madder, etc yield red dye, golden rod, teak Marigold etc. yield yellow dye, indigo wood etc (Patil *et al*., 2012). The art of dyeing spread widely as civilization advanced (Krishnamurthy *et al*., 2002). Some of the well-known ancient dyes used in India since ca. 2500 years include madder, a red dye made from the roots of the *Rubia tinctorum* L., blue indigo from the leaves of *Indigofera* L., yellow from the stigmas of the saffron plant (*Crocus sativus* L.) and from turmeric (*Curcuma longa* L.).This has been well established during the excavations of Harrappan culture. At Atharveda carries description of natural dyes. Bhrugu Samhita was written using natural dyes. Ancient India was particularly advanced in dyeing techniques and has been known since the sixteenth century for their vibrant colors and designs on fabrics. Resist-dyeing techniques probably originated in the country. During the early 1840s demonstrated the identity of a basic compound obtained from various sources.

2. Materials and Methods

2.1. Plants selected for the extraction of dyes.

Cassia fistula L.

Cassia fistula, commonly called golden shower tree, is a small to medium-sized tree that typically grows to 30-40‘ tall in an upright form of ten open at the top. It is native to India, Malaysia and Southeast Asia. *Ananas comosus* (L.)The pineapple is aherbaceousperennial, which grows to1.0 to1.5 m (3 ft 3 in to 4 ft 11 in) tall on average, although sometimes it can be taller. The plant has a short, stocky stem with tough, waxy leaves. When creating its fruit, it usually produces up to 200 flowers.

Anacardium occidentale Linn.

The cashew tree is large and evergreen, growing to 14 metres (46 feet) tall, with ashort, often irregularly shaped trunk.

2.2 Methods used in this study

Crude extract from the dried pod extracted of were prepared by adding 50 gm dry powdered material to 200 ml distilled water. The mixture was stirred, heated and maintained and boiled for 1 hour at 1009m 40°C. Occasionally add enough water to any water that boiled away. Filter the solution using Whatsmann filter paper NO.1. Extraction of fibers from mature *Ananas comosus* (L.) Merr. plant leaves are harvested from the field for fiber extraction. The fiber to be used for the dyeing Is extracted from the leaf of *Ananas comosus* (L.) Merr. by keeping the leaf in water taken in a container for aboutfour weeks and the fiber is obtained by the action of microbes through biodegradation process. The green portion of the leaf is removed mechanically by the action of scalpels in water itself.

The pod extract of *Anacardium occidentale* Linn. Was used as a natural mordant. The pod was cut into small pieces and crushed it to yield the pod extract. The process by which the natural impurities (oil, wax, fat etc) & added/external impurities (dirt, dust, etc.) are removed from the cotton fabric is called scouring 10% NaOH is used for scouring. Dyeing of cotton fabrics and fiber was carried out by dyeing of cotton without the use of mordant, pre- mordanting, simultaneous mordanting and post mordanting. Four chemical mordants namely Ferroussulphate, Potassium dichromate, Tannic acid and Copper sulphate, were used for the treatment. The cloth and fiber extracted were immersed in 50ml dye bathand boiled for one hour. After boiling the fabric was kept in dye bath for 24 hours. Then removed the cloth pieces from dye bath and allowed them to dry. After drying, the cloth pieces were washed in distilled water and dried. The dyed cotton fabrics and fiber were washed thoroughly using tap water. The fabric and fiber was exposed

to sun light for 24 h.

The colour fastness to light was evaluated by comparison of colour change of the exposed portion to the unexposed original material. crude dye solution was extracted by boiling the dried, powdered flowers (50gm) in 150 ml distilled water and different mordants were used for dyeing cotton fabricand fiber. Dyeing with mordants like Ferrous sulphate, Copper sulphate, Potassium dichromate gives more colour intensity in cotton fabric dyeing with mordants like Tannic acid and natural mordant that is the pod extract of *Anacardium occidentale* Linn.

3. Results and Discussion

The colour formed In the cotton fabric were varied according to the type of moradant used for the dyeing process. The mordants like Ferrous sulphate, Copper sulphate, Potassium dichromate, Tannic acid gives different shades of brown in cotton and the natural mordrant which extacted from the pods of the *Anacardium occidentale* Linn. also gives the shades of brown to the cotton fabric.

Table-1 Sources of fiber dyes in respective of its color development on cloth and fiber

Source of Fiber	Volume of dye bath in ml	Boiling time in hour	Condition of dye bath	Colour of cloth developed	Colour of fiber developed.
Dyeing of cotton and fiber extracted from *Ananas cosmosus* using dried and powdered pod of *Cassia fistula* L. without mordant (Fig 3.1)	50 ml	1hr	Dyeing without mordrant	Khaki	Khaki
Dyeing of cotton and fiber extracted from *Ananas cosmosus* (L) Mere. Using dried and powdered pod of *Cassia fistula* Linn. (Fig 3.2)	50 ml	1hour	Pre-mordatingPotassium dichromate	Curry brown	Curry brown
Dyeing of cotton and fiber extracted from *Ananas cosmosus* (L) Merr. Using dried and powdered pod of *Cassia fistula* Linn. (Fig3.3)	50 ml	1hour	Pre–mordanting. Ferrous Sulphate	Dirt brown	Dirt brown
Dyeing of cotton and fiber extracted from *Ananas cosmosus* (L.) Merr. using dried and powdered pod of *Cassia fistula* Linn. (Fig3.4)	50 ml	1hour	Pre–mordating. Copper Sulphate	Bronze brown	Bronze brown

Source of Fiber	Volume of dye bath in ml	Boiling time in hour	Condition of dye bath	Colour of cloth developed	Colour of fiber developed.
Dyeing of cotton using dried and powdered pod of *Cassia fistula* Linn. (Fig3.5)	50 ml	1hour	Pre-mordanting Tannicacid	Paper bag brown	Paper bag brown
Dyeing of cotton and fiber using dried and powdered pod of *Cassia fistula* Linn. (Fig3.6)	50 ml	1hour	Pre-mordanting	Brulap brown	
Dyeing of cotton and fiber using dried and powdered pod of *Cassia fistula* Linn. (Fig3.7)	50 ml	1hour	Simultaneous Mordanting. Potassium dichromate	Birch brown	Birch brown
Dyeing of cotton and fiber using dried and powdered pod of *Cassia fistula* Linn. (Fig3.8)	50 ml	1hour	Simultaneous Mordanting Ferrous Sulphate	Sawgrass brown	Sawgrass brown
Dyeing of cotton and using dried and powdered pod of *Cassia fistula* Linn. (Fig3.9)	50ml	1hour	Simultaneous mordanting Copper Sulphate	Chai brown	Chai brown
Dyeing of cotton using dried and powdered pod of *Cassia fistula* Linn. (Fig 3.10)	50 ml	1hour	Simultaneous mordanting Tannic acid	Bronze brown	Bronze brown
Dyeing of cotton using dried and powdered pod of *Cassia fistula* Linn. (Fig 3.11)	50 ml	1hour	Simultaneous mordanting	Bronze brown	Bronze brown
Dyeing of cotton and fiber using dried and powdered pod of *Cassia fistula* Linn. (Fig 3.12)	50 ml	1hour	Simultaneous mordanting Potassium dichromate	Desert brown	Desert brown.
Dyeing of cotton and fiber using dried and powdered pod of *Cassia fistula* Linn. (Fig 3.13)	50 ml	1hour	Post–mordanting Ferrous Sulphate	Saw grass brown	Sawgrass brown

Dyeing of cotton and fiber using dried and powdered pod of *Cassia fistula* Linn. (Fig 3.14)	50 ml	1hour	Post–mordanting Copper Sulphate	Bronze brown	Bronze brown
Dyeing of cotton and fiber using dried and powdered pod of *Cassia fistula* Linn. (Fig 3.15)	50 ml	1hour	Post–mordanting Tannicacid	Camel brown	Camel brown
Dyeing of cotton using dried and powdered pod of *Cassia fistula* Linn. (Fig 3.16)	50 ml	1hour	Post–mordanting	Sand stone brown	Sandstone brown

Many plants and some animals have been identifiedas potentially rich in natural dye contents, and some of them have been used for natural dyeing for quite some time. Various parts of plants like roots, stems, barks, leaves, fruits and seeds may contain colouring matter which can be exploited. Normally natural dyes are extracted from the roots, stems, leaves, flowers, fruits of various plants, dried bodies of certain insects and minerals. Some plants may have more than one colour depending upon which part of the plant one uses. The shade of the colour a plant produces will vary according to time of the year the plant is picked, how it was grown, soil conditions, etc. The minerals in the water used in a dye bath can also alter the colour. Some natural dyes contain natural mordants. Most red dyes are found in roots or barks of plants or camouflaged in the bodies of dull grey insects. Unlike the wide abundance of yellow, the sources of red colour are limited. Simultaneous mordanting and post mordanting using five selected mordants such as Ferrous sulphate, Copper sulphate, Potassium dichromate, Tannic acid and a natural mordant as pod extract of *Anacardium occidentale* Linn. Were done. Cochineal is an important red dye and it is the brightest of all the available natural red dyes. Yellow is the liveliest and perhaps the most abundant colour in nature. The plants which yield yellow dyes outnumber those yielding other colours. Dyes do not combine directly with the material they are intended to colour. Natural dyes are substantive, need a mordant to fix to the fabric, and prevent the colour from either fading with exposure to light or washing out. These compounds bind the natural dyes to the fabric. *Cassia fistula* Linn. Pod can be exploitedas a good source of natural dye for fiber extracted and cotton dyeing. Extraction of dye from *Cassia fistula* Linn. is very simple while comparing to other natural dye.The process of dyeing Is carried out in a variety of ways depending on the specific dye utilized (Rajesh Yadav *et al.,* 2014). Dyeing of cotton fabric and fiber extracted from *Ananas comosus* (L.) Merr. Without mordant, pre mordanting. When the fabric was heated in dye bath without mordants, give comparatively bright colour and also wash fastness property was also poor. Detailed scientific studies with natural dyes have established that in most cases their properties are

comparable to those of scientific dyes. Therefor, if natural dyes have to be commercialized, they need to confirm to the same stringent standards of performance that are applied to synthetic dyes. It thus follows that much more research and development effort needs to go inthis area (Jothi, 2008), The Indian subcontinent possesses large plant resources, only a little has been exploited so far. So more detailed studies and scientific investigations are needed to assess the real potential and availability of natural dye yielding resources. Mordants play an important role in imparting colour to the cotton and fiber extracted. Better colour strengths results are depends on the metal sail used (Kamel *et al*., 2004). The different types of mordant and method of mordanting significantly affect the rate and extend of photo fading (Gupta *et al.,* 2004). The cotton and fiber extracted from *Ananas comosus* (L.) Merr. fiber when dyed with dried and powdered pod of *Cassia fistula* L. gives different colour shades. The mordants such as Ferrous sulphate, Copper sulphate, Potassium dichromate gives more intense colour to the fiber extracted and cotton than the Tannic acid and natural mordant *Anacardium occidentale* L. The different colour shades on the fiber extracted from *Ananas cosmosus*(L) Merr. and cotton depends on the type of mordant used for the dyeing process. The strong coordination tendency of iron enhances the interaction between the fiber and dye, resulting high dye uptake (Jothi,D.,2008).Ferrous sulphate has theability of forming co-ordination complexes.

4. Conclusion

Natural dyes as the name suggests, come from sources found in nature such as plants, animals, fruits, because they come from natural sources, natural dyes are not harmful to the environment, which makes it so appealing for consumers. Natural dyes are biodegradable and disposing them don‘t cause pollution. Natural dyes are obtained from renewable sources. Some natural dyes, such as carmine found in lipsticks, will not cause harm orhealth problems when ingested. These can be produced without imposing harm to the environment.From this study, it could be concluded that the natural dye extracted from pod of *Cassia fistula* L. Can be used as a source for cotton and fiber dyeing. Dyeing of cotton and fiber were carried out by dyeing of cotton without the use of mordant, pre-mordanting, simultaneous mordanting and post-mordanting. There were different mordants used for dyeing purpose which includes Copper sulphate, Ferrous sulphate, Potassium dichromate, Tannic acid and natural mordant was also used which was the pod extract of *Anacardium occidentale* L. After dyeing of cotton and fiber the different colour shades such as black, brown, and red are obtained. From the result obtained it is found that the dye obtained from *Cassia fistula* L. is an adjective as it needed a mordant to fix the dye to the fabric and fiber. Dyeing of cotton and fiber without mordant yield colour shade such as khaki. When the pre- mordanting, simultaneous mordanting and post- mordanting, is done with mordant ferrous sulphate the colour developed in the cotton fabric and fiber were the dirt brown, Olive brown and Saw grass brown respectively. When the pre- mordanting, simultaneous mordanting and post-mordanting, is done with mordant Copper sulphate the colour developed in the cotton fabric and fiber were the curry brown, chai brownand bronze brown respectively.

Figures 3.1-3.16 : Sources of fiber dyes in respective of its color development on cloth and fiber

Fig.3.1

Fig3.2

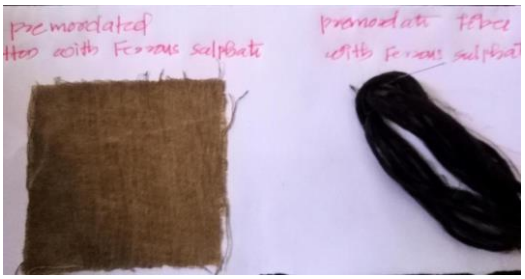


Fig.3.3

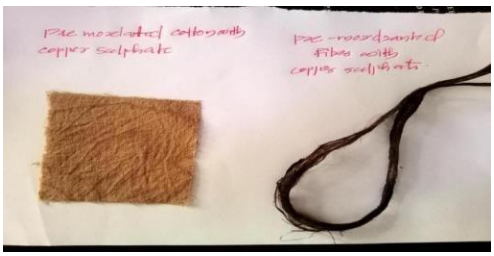


Fig.3.4

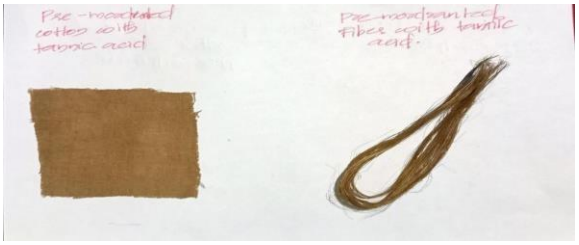


Fig 3.5

Fig 3.6

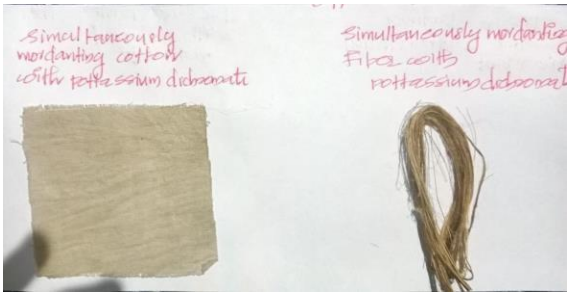


Fig 3.7

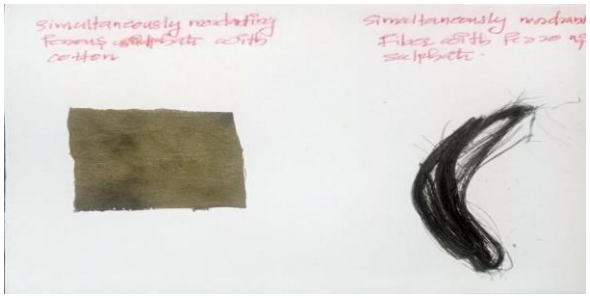


Fig 3.8

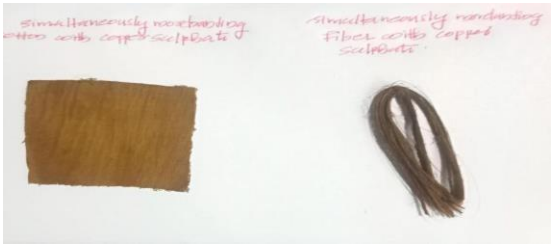
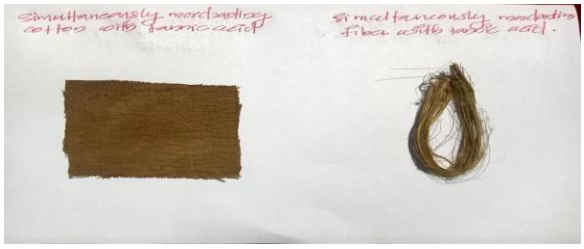


Fig 3.9



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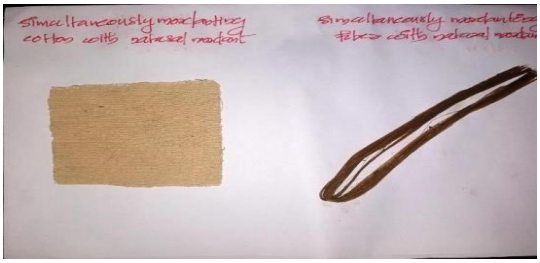

Fig3.11

Fig3.12

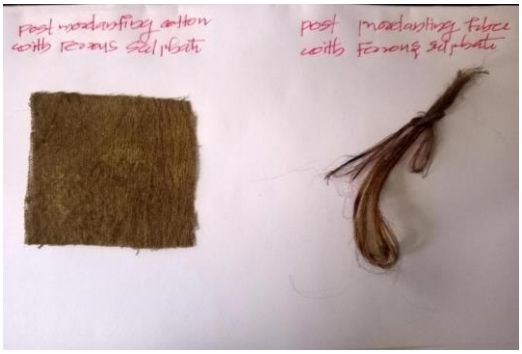

Fig3.13

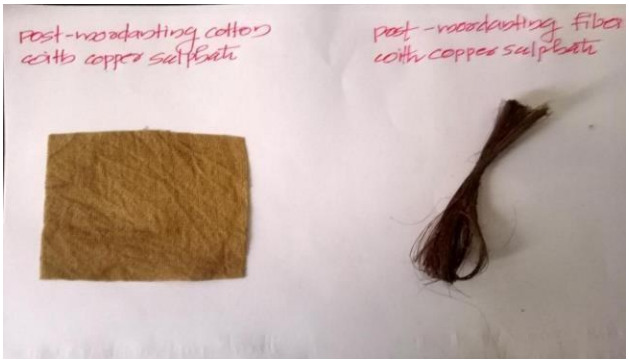

Fig3.14

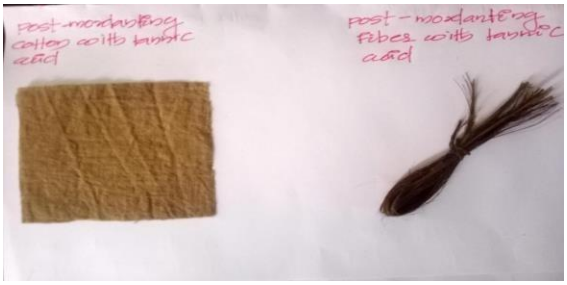

Fig3.15

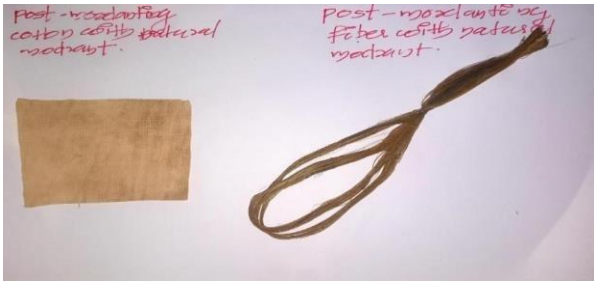

Fig3.16

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