FASTNESS PROPERTIES OF COLOURANTS EXTRACTED FROM LOCUST BEANS AND TAMARIND FRUITS PODS

IBRAHIM ABDULLAHI UMAR*

Abstrak

Kepentingan meningkat untuk pewarna semulajadi bermula beberapa tahun lalu tetapi di pihak pengguna, manfaat tersebut hanya mula dirasai. Pewarna asli dianggap sebagai pewarna mampan dan mesra alam; mereka boleh menghasilkan warna yang berbeza warna dan mempunyai ketahanan luntur yang lebih rendah daripada pewarna sintetik. Oleh itu, kertas kerja ini dikaji pada sifat kubu daripada pewarna yang diekstrak daripada kacang belalang dan buah-buahan asam buah.Warna-warna ini dipetik menggunakan kaedah berair dan pelarut dan telah digunakan di dataran terluntur ditenun kapas dan sutera kain.Yang digunakan bagi pedas meningkatkan penembusan warna (pewarna) dan sampel dicelup telah tertakluk kepada ujian kubu (membasuh, menggosok, peluh & ujian cahaya). Perbandingan analisis kepada tahap pewarnaan telah direkodkan dan ujian kubu baik daripada analisis membuktikan bahawa; warna boleh digunakan sebagai pewarna pada kapas dan sutera kain.

Kata kunci: Berair dan Pengekstrakan Pelarut, Pewarna Warna, Kapas dan Kain Sutera, Harta Kubu.

Abstract

An interest for natural dyes increased several years ago but on the part of the consumers, the benefits are just beginning to be felt. Natural dyes are considered as sustainable and ecofriendly dyes; they can produce different shades of colours and have lower colour fastness than synthetic dyes. Therefore, this paper researched on the fastness properties of colorant extracted from locust beans and tamarind fruits pods. The colours were extracted using aqueous and solvent methods and were applied on bleached plain weaved cotton and silk fabrics. The use of mordant increased the penetration of the colours (dyes) and the dyed samples were subjected to fastness test (washing, rubbing, perspiration & light test). Comparative analyses on the degree of staining were recorded and good fastness test from the analysis proved that; the colours can be used as dyes on cotton and silk fabrics.

Keywords: Aqueous and Solvent Extraction, Colour dye, Cotton and Silk Fabrics, Fastness Properties.

* Pelajar Sarjana di Fakulti Teknologi Kreatif dan Warisan, Universiti Malaysia Kelantan (UMK).

1.0 Introduction

The use of natural colors for dyeing fabrics has been in practice since ancient times, where most of the dye color are obtained from the plants parts (leaves, flowers, stem, roots, fruits and pods (Adeel et al, 2009; Kanez, 2004). The advent of synthetic dyes during 1856-1900 jeopardized the market of natural colorants, as synthetic dyes were cheaper and gave excellent fastness and reproducible color shades (Samanta&Konar, 2012). The growing awareness of environmental problems coupled with the toxicity associated with synthetic dyes, brings back the promising prospects of nature to the cheaper extraction technology of colorants from natural, renewable resources plants parts (Kulkarni, 2011).

It is on this footstep of global concern over the use of an eco-friendly and biodegradability of natural materials that this research work bends on two of the famous plants known as locust beans (An Answer to Africa's Greatest Needs in One Tree) also refers to as (parkiabiglobosa/filicoidea) and tamarind tree, the trees are multi- purpose which are cultivated over a wide area in the world, especially within the African sub region, it occurs in large numbers, from the Atlantic coast in Senegal to Sudan and northern Uganda (Sina and Traore, 2002). In Africa, the Western Sahara and Nigeria in particular the plants play a vital role, but the exploitation have not been done as a means of natural dyes (Figure 1a & 1b) The belt is the widest in West Africa (maximum of 8000kms) and narrows to the east, about 201,000 ton of the locust beans fruit is being produced in the Northern Nigeria annually, (Sina and Traore, 2002), while matured tamarind tree can produce annually 150-225tons of the fruits (Morjon,1987).

te 01 Close up view of Locust Bean fruit.

Figure 1a: Locust Beans Fruit

Figure 1b: Tamarind Fruit

2.0 Problem Statement

The production and application of Synthetic dyes have been excessively used worldwide (Jothi, 2008).The released of vast amount of waste and un-fixed colorants, causing serious health hazards and disturbing the eco-balance of the nature, by damaging the plants in terms of growth and good yields, it is toxic to human body causing skin cancer (Samanta&Konar, 2011). This problem also coincides with Nigerian problem of scarcity of dyes which is confronting the dyers, creating unemployment opportunity, high cost of production, environmental pollution. This causes the researcher to investigate the used of waste fruits pods of locust beans and tamarind fruits, to extract color that can be used for dyeing and other application of color on natural fabrics.

3.0 Purpose of This Study

The aim of this study is to; identify an eco-friendly natural resources plant parts with much accessibility in quality of color, less in price, renewable, in which locust beans and tamarind fruit pods have such possibilities. The specific objectives are:

- To determine the availability of the plants under study as well as its acceptability by dyeing industries.
- To make sure color fastness, shade, brilliancy is acquired to enhance quick adaptation as a substitute to the synthetic dyes.
- To determine the marketability of the processed plants, when adopted as a substitute to the synthetic dyes.

4.0 Significance of This Study

The study will be most significant to; local dyers, small and medium textile industries, and other organizations that deal with dyes and coloring, farmers, corporate organizations, government and as a means of employment to our teeming youth.

5.0 Literature Review

The primitive society discovered that certain leaves, roots, fruits, and barks of plants can be manipulated, usually in a liquid form, to use as dyes on fabrics, they used other techniques to decorate clothing, utensils and even their body (Charity, 2008). Natural dyes can be extracted from plants sources through many methods such as aqueous (using distilled water), solvent (methanol/ethanol), and other methods include

the use of enzymes (using alcohol/organic acids); and benzene is also possible (Samanta&Konar, 2009). The extraction of pomegranate (punicagranatum) peel, was carried out, by drying, grinding into powder form, then soaked the sample into water overnight to obtained crude dyestuff, filtered to obtained pure dye liquor (Kulkarni et al, 2011). There are other methods such as acid/alkaline, ultrasound assisted extraction process (Samanta et al, 2007; Sumate et al, 2008; Tiwari et al, 2010).But under these study, aqueous and solvent methods were used.

6.0 Methodology

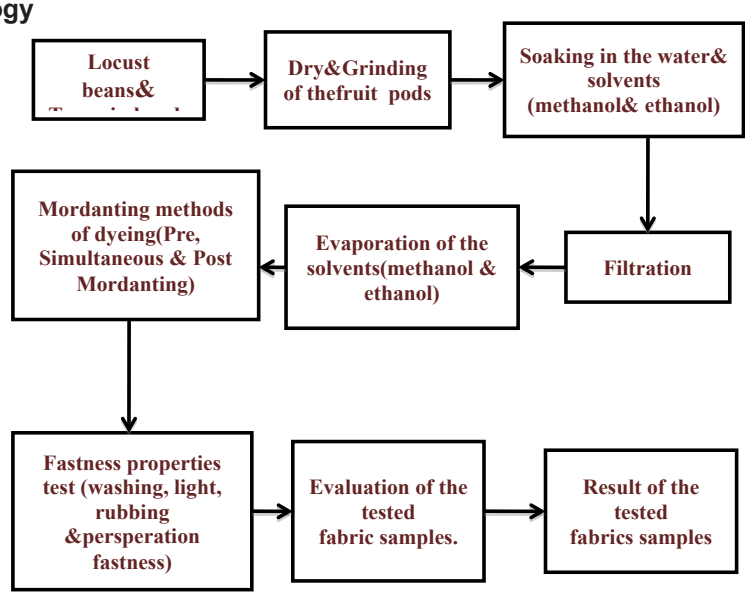

Figure 2.1. Illustration of Extraction & Dyeing Procedure

Figure 2.2. Dried and Grinded of Tamarind Fruit Pods Powder.

Figure 2.2. Dried and Grinded of Locust Beans Fruit Pods.

7.0 Result and Discussion

7.1 Introduction

The present study was undertaken to dye plain weave cotton and silk fabrics with colour extracted from locust beans and tamarind fruit pods in aqueous and solvent medium respectively. The dyeing was carried out at the conditions temperature of 100°c for 10 minutes, using 400mls of the dye extract and 100mls of mordant solvent namely; Aluminium potassium sulphate (ALUM), Copper (II) Sulphate, Iron (II) Sulphate, and Iron (III) Sulphate. Each of the mordant was used in all the three mordanting methods namely; pre-mordanting, simultaneous mordanting, post-mordanting for dyeing. After dyeing the solution was allowed to cool, to remove the fabrics from the dye bath, to rinse under running water to remove excess dye particles and shade dries, the dyed fabrics were then subjected to colour fastness test on washing, rubbing, exposure to light and perspiration. The tested samples were evaluated with grades and the results were established based on the graded value obtained.

7.2 Evaluation of Colour Fastness

Colour fastness to washing of the dyed fabrics samples was determined as per MS ISO: 764-1987 methods using washing fastness machine (Linitest) (Figure 3.1). The wash fastness rating was assessed using grey scale as per ISO-105-A02 (loss of colour shade/depth) and ISO-105-A03 (extent of staining). The colour fastness fabric samples sizes used for washing fastness was 4×2 centimetres and sandwich stitched between a white wool and cotton fabrics of the same sizes with the sample sized, 8 fabrics samples were soaked inside washing pots containing 100mls of washing detergent, and were inserted inside the pots holes, the machine was operated and run for 30 minutes. The washed samples were removed, rinsed under running distilled water and squeezed to remove excess water on it and shade dried. After, the samples were unstitched and then pressed heat at appropriate temperature, then ready for grading.

Figure 3.1. The Washing Machine (Linitest)

The colour fastness to light was determined as per MS ISO: 2450-1987 method. The light fastness was tested by exposing the sample to Ultraviolet light (UVL) in a Xenotest220 machine (Figure 3.2) for 24 hours, the samples size used for the tests is 2×1cm, and were stapled to a prepared card plate, where cotton and silk fabrics according to the dye extract used were on each card plate and were assemble into the light fastness machine plates (metallic). About 20 samples were assembled at a time into the machine and were run for 8 hours; the machine runs automatically in case of electricity problem and when electricity was switch off. The samples were removed after the period and ready for grading. The fading of each sample was observed against the fading of blue wool standard (1-7).

Figure 3.2. The Light Fastness Machine (Xenotest220)

Colour fastness to rubbing (dry and wet) was assessed as per MS ISO: 766-1987 method using a manually operated crock meter and grey scale as per ISO: 105-A03 (extent of staining). The prepared cotton and silk samples measuring 8×4 centimetres were attached on a piece of white wool fabrics 2×2 centimetres and labelled on each wet/dry, then ready for the test. The prepared white woollen fabric was tied to the stroking tip and the fabrics under test were inserted in the prepared box (metallic) and set the machine to zero (0), then run the machine. After 20 strokes the machine was stop, the fabrics sample and the prepared white wool that rubbed on the samples were removed. Distilled water was used for the wet test on the rubbed surfaced of the white wool prepared, at the end of all the rubbing the samples were taken for grading.

Figure 3.3. Picture of the Rubbing Machine (Crockmeter)

The colour fastness to perspiration was assessed according to IS-971-1987 method. The specimen was stitched at two sides to a piece of white wool fabric measuring 4×2 centimetres and was soaked in the test solution of (acidic & alkaline) separately with a liquor ratio of 1:50 for 30 minutes at room temperature. The samples were then placed in between two glass plates of perspiration, under load of 4.5kilogrammes (10 lbs). The apparatus was then kept in the oven for 4 hours at 37±2°c. At the end of this period, the specimen was removed, un-stitched at one end, hung for drying in oven at a temperature not exceeding 60°c. for one hour.

Figure 3.4. Picture of Perspiration Machine

The beauty of colour on any fabric is of no value to the consumer, unless the dye may be considered fast under the conditions in which the fabric will be used. Colour must meet tests such as washing, ironing, steaming, perspiration, strong light, rubbing and the effects of acid/ alkaline(Corbman, 1983). Therefore, under this study only washing, light, rubbing, and perspiration tests were conducted; the tested samples were graded for change in colour and staining using grey scales (Figure 3.5). All the tested specimens were graded and results were arranged in the Tables 3.1 - 3.6, according to the medium combination.

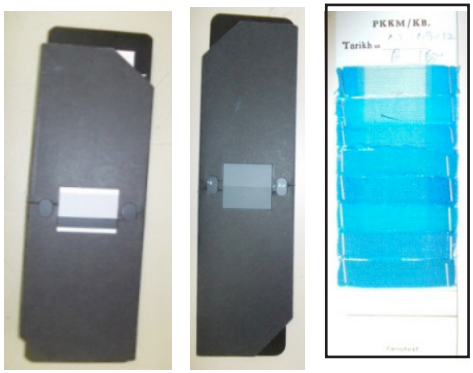

Figure 3.5: The Picture of the Grey Scales

7.3 Locust Beans and Tamarind Fruits Pods Extracted in Aqueous Combination

The evaluation of colour fastness to washing, light, rubbing and perspiration test on dyed cotton and silk fabrics samples extracted from locust beans and tamarind fruits pods treated with Alum (aluminium potassium sulphate), Copper (II) Sulphate, Iron (II) &Iron (III) Sulphates in aqueous medium combination are presented below in tables 1&2.

All the treated samples subjected to washing fastness show fairly good (3-4), for both plants and no colour change, with negligible staining, except for locust beans extracted dyed without mordant on silk fabric showed fair(2) to colour change. The exposure to light showed excellent to good (7-6, 6-5 &5-4) for all the treaded samples, except for tamarind pods extracts on simultaneous mordant with alum for both cotton and silk where its shows fair (2-3). Rubbing fastness test samples show excellent to good (5,& 4-5) on all the treated samples, except for post- mordant cotton wet (3-4) shows fair to good on both tamarind and locust beans pods respectively, but no colour change and negligible staining(4-5). Perspiration fastness test shows excellent to good (4-5), fairly good (3-4) for both acidic and alkaline in locust beans and tamarind fruits pods extracts, except for pre-mordant in alum on cotton, post-mordant in alum on silk for locust beans pods extracts exhibited loss of colour shade (1), while tamarind fruits pods extracts in simultaneous mordant with iron(II) sulphate on silk, post-mordant with copper(II) sulphate on cotton shows loss of shade(2) respectively, but no colour change and negligible colour staining on almost all the treated samples in acidic and alkaline media.

Table 1. Fastness Grades of Locust Beans Fruits Pods on Cotton and Silk Fabrics at Dyeing Time of 10minutes at 100ºC Temperature in Aqueous Medium

Mordanting Method	Type of Mordant Used	Locust Beans Pod A																			
		Cotton										Silk									
		Light Grades	Washing		Rubbing			Perspiration				Light Grades	Washing		Rubbing			Perspiration			
			Grades		Grades			Grades					Grades		Grades			Grades			
					Dry		Wet	Acidic		Alkaline					Dry		Wet	Acidic		Alkaline	
			CC	CS	CC	CC	CS	CC	CS	CC	CS		CC	CS	CS	CC	CS	CS	CS	CC	CS
Pre-Mordanting	A	4	3	5	5		4-5	1	4-5	1	4-5	4	4	5	5		4-5	4-5	5	4-5	5
	B	5-6	3-4	4	4-5		4	4	4-5	4	4-5	5	3	4	4-5		4	4	5	4	5
	C	6	3-4	4	4-5		4	3-4	5	3-4	5	6	3	5	4		4	3-4	4-5	3-4	4-5
	D	5	4-5	4	4		4	3-4	4-5	4	4-5	5-6	4	5	4		4	3	4-5	3-4	4-5
Simultaneous Mordanting	A	5	4-5	5	5		4-5	4	4	3-4	4	5-6	3	4	5		4-5	4	5	3-4	5
	B	5-6	3-4	4	4-5		4	4	5	3	4	6	3	4	4-5		4	4	4-5	3-4	4-5
	C	6-7	3	4	4-5		4	3	5	3	5	6-7	3-4	5	4		4	3	5	3-4	5
	D	5-6	3-4	4-5	4-5		4	3-4	5	4	5	5	4	5	4		4	4-5	5	4-5	5
Post-Mordanting	A	4-5	3	4	5		4	2-3	4-5	3-4	4-5	4-5	3	4-5	4-5		4-5	1	5	1	5
	B	6	4	5	4-5		4	4	4	3	4	6	3	5	4		4	4	4-5	4	4-5
	C	6-7	3	3-4	4		3	3	4	3	4	7	3	4	4		3-4	3	4-5	4	4-5
	D	5	3	4-5	4-5		4	3-4	5	3	5	5	3	4-5	4-5		4	3	5	3-4	4-5
Without Mordanting		4	3-4	4	5		4	3	4-5	3	4	4	2	3-4	4-5		4-5	3	4-5	3	5

Key: A - Aluminium Potassium Sulphate C - Iron (II) Sulphate CC - Colour Change
B - Copper (II) Sulphate D - Iron (III) Sulphate S - Colour Staining

Table 2. Fastness Grades Of Tamarind Fruits Pods On Cotton And Silk Fabrics At Dyeing Time Of 10 Minutes At 100ºC Temperature In Aqueous Medium Combination

Mordanting Method	Type of Mordant Used	Tamarind Pod A																		
		Cotton									Silk									
		Light Grades	Washing		Rubbing		Perspiration				Light Grades	Washing		Rubbing			Perspiration			
			Grades		Grades		Grades					Grades		Grades			Grades			
					Dry	Wet	Acidic		Alkaline					Dry	Wet		Acidic		Alkaline	
			CC	CS	CS	CS	CC	CS	CC	CS		CC	CS	CC	CS	CC	CC	CS	CC	CS
Pre-Mordanting	A	7	3-4	4-5	4		4	3	5	4	5	7	3	5	4		4	4	5	3-4	5
	B	7	4	4	4		4	3-4	5	3	5	6	3	4-5	4		4	3-4	5	4	5
	C	6	4	4	4							6									
	D	6	4	4	4		4	4	5	3-4	5	5-6	3	5	4		4-5	3-4	5	3	5
Simultaneous Mordanting	A	2-3	4	4-5	4		4	3-4	5	4	5	3	3-4	5	4		4	3	5	3-4	4-5
	B	5-6	4	5	4		4	3-4	5	3	5	6	3-4	5	4		4	4-5	5	4	5
	C	5-6	3	5	4		4	3	5	4	5	5-6	3	5	4		4	2	5	3	5
	D	7	4	4-5	4		3-4	4	5	3-4	5	5	3	5	4		4	3	5	3-4	5
Post-Mordanting	A	7	3-4	4	4		4	4-5	5	4-5	5	7	3	5	4		4	4	5	4	5
	B	6	4	5	5		4-5	2	5	3-4	5	6	3	5	4-5		4-5	3-4	5	4	5
	C	5-6	3-4	5	4-5		3-4	3	5	4-5	5	5-6	3	5	4		4	4	5	3	5
	D	7	3-4	4-5	4		3-4	4	5	4	5	5-6	3	5	4		3-4	2-3	5	3	5
Without Mordanting		5-6	4	4-5	4		4	4	5	4-5	5	5-6	4	5	4		4-5	3	5	3	5

Key: A - Aluminium Potassium Sulphate
B - Copper (II) Sulphate
C - Iron (II) Sulphate
D - Iron (III) Sulphate

CC - Colour Change
CS - Colour Staining

7.4 Locust Beans and Tamarind Fruits Pods Extracted in Methanol Medium Combination

The evaluation of colour fastness to washing, light, rubbing and perspiration fastness test on locust beans and tamarind fruits pods extracted dyed cotton and silk fabrics samples treated with Alum, Copper(II) sulphate, Iron (II) & Iron(III) sulphates in methanol medium combination is presented in table 3 & 4.

All the treated samples subjected to washed fastness test on the treated samples showed fairly good (4, & 3-4), no colour change with negligible colour staining on cotton and silk in locust beans dyed extracts, while the tamarind dyed extracts showed fairly good (4, & 3-4) also, no colour change with negligible colour staining on cotton and silk samples. For the light exposure to fastness test, all the treated samples showed excellent to good (7, 6-5 & 4) for locust beans dyed extracts on cotton and silk, while tamarind dyed extracts showed excellent to good (7,6-5 &5) and fair in colour change (3) in pre-mordant and simultaneous mordant in alum on both cotton and silk.

Rubbing fastness test shows excellent to good (5, & 4-5) for all the treated samples, except for pre-mordant, post-mordant on cotton wet and silk dry for locust beans pods dyed extract respectively, while tamarind showed excellent to good (5, & 4-5) and fairly good (3-4) only. Perspiration fastness

test on methanol medium combination showed that the treated samples of locust beans pods extracts have fairly good (3-4), no colour change and negligible staining (5) in both acidic and alkaline media, while tamarind fruits pods extracts also showed fairly good (3-4), except for pre-mordant acidic on silk showed fair (2-3), and post-mordant alkaline on cotton and silk acidic shows also fair grading (2-3), but no colour change and staining in both acidic and alkaline media.

Table 3. Fastness Grades Of Locust Beans Fruits Pods Extract On Cotton And Silk Fabrics At Dyeing Time Of 10 Minutes At 100ºC Temperature In Methanol Medium Combination.

Mordanting Method	Type of Mordant Used	Locust Beans Pod B																			
		Cotton										Silk									
		Light Grades	Washing		Rubbing		Perspiration					Light Grades	Washing		Rubbing		Perspiration				
			Grades		Grades		Grades						Grades		Grades		Grades				
					Dry		Wet		Acidic		Alkaline				Dry		Wet		Acidic		Alkaline	
			CC	CB	Cc	CB	CC	CC	CB	CC	CB		CC	CB	CC	CB	CC	CC	CB	CC	CB
Pre-Mordanting	A	3	3	4	5		5	3-4	4-5	3	4-5	3	4	4	5		4-5	4-5	4-5	3	4-5
	B	5	3-4	5	4-5		4-5	4	5	3-4	5	5-6	3	4-5	4		4	3	5	3-4	5
	C	6	3	4	4		2-3	3	5	3-4	4-5	6	3-4	4	2-3		3	3	4-5	3-4	4-5
	D	6-7	3	4	4		4	3	5	3-4	5	7	4	4	3-4		4	3	5	3-4	5
Simultaneous Mordanting	A	3	3	5	5		4	4	5	3	5	3	3-4	5	4-5		4-5	4-5	5	4	5
	B	5-6	3	4	4		4	3	4-5	3-4	4-5	6	4	5	4		4	3-4	5	4	5
	C	5-6	3-4	4-5	4		4	4	5	3	5	5-6	3-4	4	4		4	3	5	3-4	5
	D	6	3-4	4	4		3	3-4	5	3-4	5	5-6	3-4	5	4		4	3	5	3	5
Post-Mordanting	A	4-5	3-4	4	4-5		4	3	5	3-4	5	4-5	3	4	4-5		4-5	4	5	3	5
	B	6	4	4	4		4	3	5	3-4	5	6-7	4-5	5	4		4	3-4	5	3	5
	C	5	4	4	4		3	3	5	3-4	4-5	5-6	3-4	5	4		4	3-4	5	3-4	5
	D	4-5	4	4-5	4		2-3	3-4	5	3	5	4	3-4	4-5	4		4	4	5	3-4	5
Without Mordanting		3	3	4	4-5		4	4	5	4-5	5	3	3	4	4-5		4-5	4	5	3	5

Key: A - Aluminium Potassium Sulphate
B - Copper (II) Sulphate
C - Iron (II) Sulphate
D - Iron (III) Sulphate

CC - Colour Change
CS - Colour Staining

Table 4. Fastness Grades Of Tamarind Fruits Pods Extract On Cotton And Silk Fabrics At DyeingTime Of 10minutes At100ºC Temperature In Methanol Medium Combination

Mordanting Method	Type of Mordant Used	Tamarind Pod B																		
		Cotton										Silk								
		Light Grades	Washing		Rubbing		Perspiration					Light Grades	Washing		Rubbing		Perspiration			
			Grades		Grades		Grades						Grades		Grades		Grades			
					Dry		Wet		Acidic		Alkaline				Dry		Wet		Acidic		Alkaline	
			CC	CS	CC	CS	CC		CC	CS	CC	CS			CC	CS	CC		CC	CS	CC	CS
Pre-Mordanting	A	3	4	5	5		4		3	4-5	3	4-5	3	4	5	4		4	3-4	4-	4	4-5
	B	5-6	3	5	4		3-4		4	4-5	4	4-5	5-6	3-4	5	3-4		4	3	5	4	5
	C	3	3	4-5	4		4		3	5	3	5	3	3-4	4	4		4	2-3	5	3	5
	D	5-5	3-4	4-5	4		4-5		3-4	5	3	5	5-6	3-4	5	3-4		4	3	5	4	5
Simultaneous Mordanting	A	3-4	3	4	5		4-5		4-5	5	4	4-5	3	3-4	5	4-5		4	4-5	5	5	5
	B	7	4	5	5		4-5		3	5	3-4	5	5-6	3	4	3-4		4-5	3	5	4	5
	C	7	4	5	5		4		3-4	5	3-4	5	7	4	5	4		4	2-3	5	3	5
	D	7	3-4	5	3-4		4		3	5	4	5	5-6	3	4-5	5		4	3	5	3-4	5
Post-Mordanting	A	6	3	4	4-5		4-5		3	5	2-3	5	6	3	4-5	4-5		4-5	4	5	3	5
	B	7	3-4	4-5	4-5		5		3	5	3-4	5	7	4	5	4		4	2-3	5	2-3	5
	C	5-6	4	4-5	4		5		3	5	4	5	5-6	4	4-5	4		5	2-3	5	3	5
	D	6	3	4-5	4		4-5		3	5	3-4	5	5	3-4	5	4-5		4	3	5	3-4	5
Without Mordanting		3	3-4	4-5	5		4-5		3-4	5	3	5	3	4	4-5	5		5	3	5	3	5

Key: A - Aluminium Potassium Sulphate
B - Copper (II) Sulphate
C - Iron (II) Sulphate
D - Iron (III) Sulphate

CC - Colour Change
CS - Colour Staining

7.5 Locust Beans And Tamarind Fruits Pods Extracted From Ethanol Medium Combination

The evaluation of colour fastness to washing, light, rubbing and perspiration fastness test on tamarind and locust beans fruits extracted from ethanol medium combination dyed on cotton and silk fabrics samples treated with Alum, Copper (II) Sulphate, Iron(II) & Iron (III) Sulphates in ethanol medium combination is presented in table 5 & 6.

All treated samples subjected to washing fastness test shows fairly good (3-4) for cotton and silk in locust beans extracts with negligible colour staining, and almost all the treated samples subjected to light exposure shows excellent to good (7-5) and fairly good (3-4), except for pre mordant on silk in locust beans extracts shows loss of colour shade ((2-3).The colour change to dry and wet rubbing test for all the treated samples was excellent to good (4-5), with negligible colour staining for both locust beans and tamarind pods extract respectively.

Perspiration fastness test shows fairly good (3-4) for no colour change and negligible colour staining (5) in both acidic and alkaline media for both plants, except tamarind pre-mordant in Iron (II) & Iron (III) sulphates on cotton and silk post-mordant which shows loss of colour change (2-3 & 2), also in acidic, but negligible colour staining in both acidic and alkaline media from locust beans and tamarind fruit pods.

Table 5. Fastness Grades Of Locust Beans Pod On Cotton And Silk Fabrics At Dyeing Time Of 10minutes At 100ºC Temperature In Ethanol Medium Combination

Mordanting Method	Type of Mordant Used	Locust Beans Pod C																			
		Cotton										Silk									
		Light Grades	Washing		Rubbing		Perspiration					Light Grades	Washing		Rubbing		Perspiration				
			Grades		Grades		Grades						Grades		Grades		Grades				
					Dry		Wet		Acidic		Alkaline				Dry		Wet		Acidic		Alkaline	
			CC	CS	CC	CS	CC	CC	CS	CC	CS		CC	CS	CC	CS	CC	CC	CS	CC	CS
Pre-Mordanting	A	3	3	4-5	5		4	3	5	3-4	5	2-3	3	4	4-5		4-5	4	5	4-5	5
	B	5	4	4	4-5		4	4	5	3	5	6	3	4-5	4		4	4	4-5	3	4-5
	C	5-6	3-4	5	4		3-4	3-4	5	3-4	5	5-6	3-4	5	3		3	3-4	5	3	5
	D	5-6	4	4	4-5		4	3	5	3-4	5	6	3-4	4	4		4	3	5	3-4	5
Simultaneous Mordanting	A	3	3	4-5	5		4-5	3	5	3	5	3	3	5	5		4-5	4	5	4	5
	B	5-6	3-4	4	4-5		4	3	4	3-4	4	6	4	4-5	4		4	4	5	3-4	5
	C	5	3-4	4	4-5		4	3	5	3	5	4-5	3	4	4-5		4	3	5	3-4	5
	D	5-6	3	4	4		3-4	3-4	5	3-4	5	3-4	3	5	4		4	3-4	4-5	3	4-5
Post-Mordanting	A	4	3	4	5		4	3-4	4	4	4	3	4	5	4		5	4-5	5	4	5
	B	7	4	4	4		4	4	5	4	4-5	6-7	4	5	4		4	4	4-5	4-5	4-5
	C	5-6	3-4	4	4-5		4	3-4	5	4	5	5	3	5	4-5		4	3-4	5	3-4	5
	D	4	3	4-5	5		4	3	5	3-4	5	5	3	5	4		4	4	5	3-4	5
Without Mordanting		3-4	4	4-5	5		4	4	5	4-5	5	3-4	4	5	5		5	3-4	5	3	5

Key: A - Aluminium Potassium Sulphate
B - Copper (II) Sulphate
C - Iron (II) Sulphate
D - Iron (III) Sulphate

CC - Colour Change
CS - Colour Staining

Table 6. Fastness Grades Of Tamarind Fruits Pods On Cotton And Silk Fabrics At Dyeing Time Of 10minutes At 100ºC Temperature In Ethanol Medium Combination

Mordanting Method	Type of Mordant Used	Tamarind Pod C																			
		Cotton										Silk									
		Light Grades	Washing		Rubbing		Perspiration					Light Grades	Washing		Rubbing		Perspiration				
			Grades		Grades		Grades						Grades		Grades		Grades				
					Dry		Wet		Acidic		Alkaline				Dry		Wet		Acidic		Alkaline	
			CC	CS	CC	CS	CC	CC	CS	CC	CS		CC	CS	CC	CS	CC	CC	CS	CC	CS
Pre-Mordanting	A	3-4	3	4	4-5		4	3	4-5	3	4-5	3	4	5	4-5		4-5	4	5	4	4-5
	B	5	4-5	5	4		4	3-4	5	4	5	5	3	5	4		4	4	5	3-4	5
	C	5-6	3	5	5		5	2-3	5	3	5	5-6	3-4	4-5	5		5	3-4	5	4	5
	D	5-6	3	5	5		4	3	5	3-4	5	5-6	4	4-5	4		4	2-3	5	3	5
Simultaneous Mordanting	A	3	4	4	5		4	4-5	5	3	5	3	3	4-5	5		5	4	5	4-5	5
	B	5-6	4-5	5	4		4	3	5	3-4	5	6	3	5	4		5	3-4	5	3	5
	C	5	3-4	4	4		3	3	5	3-4	5	5-6	3-4	4-5	5		4	3	5	3-4	5
	D	5-6	4	5	4		4	3	5	3-4	5	5-6	4	4-5	4		4	3	5	4	5
Post-Mordanting	A	3	3	4	5		4	4	5	3-4	4-5	3	3	4-5	5		5	3-4	5	4	5
	B	7	4	5	4-5		4	3-4	5	3	4-5	5-6	4	4-5	4		4	4-5	5	4	5
	C	6	4	4	4-5		4	3	5	3	5	5-6	4	4-5	4-5		4	2	5	3-4	5
	D	6	4	4-5	4		4	2	5	3-4	5	5	3	4	4-5		4-5	2	5	3-4	5
Without Mordanting		3	4	5	4-5		4	3	5	3	5	3	4	5	4-5		4-5	3-4	5	4	5

Key: A - Aluminium Potassium Sulphate
B - Copper (II) Sulphate
C - Iron (II) Sulphate
D - Iron (III) Sulphate

CC - Colour Change
CS - Colour Staining

8.0 Conclusion

The used of the mordant gave different shades to the fabrics, there was wide range of soft and light colors obtained both on cotton & silk, by using the dye extracted from locust beans & tamarind pods especially on methanol & ethanol medium combination. With regards to color fastness, tested samples exhibited excellent to good, except that locust beans have 6 samples with less than grade value (3), while tamarind has 4 less than (3) in aqueous combination. In methanol combination, locust beans have 3 that were less than grade value (3), while tamarind has 6 that were less than grade (3).

In ethanol combination, locust beans has only 1 sample that was less than grade (3), while tamarind have 5 samples that were less than grade value(3).However, the loss of color may be because of weakness in the molecular bonds or chemical reaction between the mordants and the acid or the dye molecules, but all extracts were good natural dyes, so recommend to be used as dyes, to textiles industries, institutions that deals with color/dyes, organizations and the government. The tamarind have more color loss (15) samples while locust beans have 10, further investigation can be done with on the color loss, other types of mordants and natural fabrics (e.g. wool, jute, etc).

References

Adeel S., Ali S., Bhatti I. A. and Zsila F. (2009). "Dyeing of cotton fabric using pomegranate (Punicagranatum) Aqueous extract". Asian J. Chem., 21(5); 3493-3499.Universal journal of Research and Technology Vol.1, Issue 2; 135-139. 2011.

F.B.Akande, O.A .Adejumo,et al. (2010).Processing of Locust Beans Fruits, Challenges and Prospects. African Journal of Agricultural Researchvol.5(17).2010Http://earthobservatory.nasa.gov/ features/ OzoneWeBreathe/ozone.

Jimoh .Y.A &Adamu Andrew. (2010).Production and Classification of Locust Beans Pod Ash (LBPD) as a Pozzolan. Http;//www-engineering civil.com/ production-and –classification-L.

Jeannie Allen. (2002). TheOzone We Breath.http://earthobservatory.nasa.gov/ features/ozone.

Joyee. (1978).Manual Of Dyes And Fabric.Thames and Hudsan, publisher London.

K. Nishinari & M. Takemasa,et al. (2007).An Answer to Africa's Greatest Needs in One Tree (Locust Beans). Http://blogs.World waych.org/ nourishing the planet/the-locust-beans-an.

Katz. (2004),Natural Plant Dyes. <http;//www.chymist.com.

Krupa el at. (2001).<http;//earthobservatory.nasa.gov./OzoneWeBreathe/ozone.>

Mantazer,M.&Parvinzadeh.M. (2007).Dyeing of Wool with Marigold and its Properties, Fibres And Polymer, 8(2), 181-185.Universal Journal Of Environmental Research And Technology vol.1, issue 2, 135-139. 2011.

NyiNyiNaing et al. (2004).Effects of Tobacco Smoking. World Health Organization (W.H.O.), 2011 Report. Ministry of Health Kelantan, Malaysia.

Onal A. (1996).Extraction OfDyestuff From Madder Plant (RubiaTinctorumL.) And Dyeing Of Wool, Feathered-Leather And Cotton. Tr.J.Chem, 20,204-214.
Padma S., Vankar.(2011).HandBook on Natural Dyes for Industrial Applications.National Institute of Industrial Research India.

Pruthi N., Chawla G.and Yadav S.(2008).“Dyeing of Silk with Barberry Bark Dye using Mordant Combination”. National Product Radiance, 7(1), 40-44., Universal Journal of Environmental Research and Technology, vol.1, 2011.

Samanta A. K. and Agarwal P. (2009).“Application of Natural Dyes on Textiles IJ FTR 34, 384—399”. Universal Journal of Environmental Research and Technologyvol. 1, 2011.

Saha, P.andDutt,S. (2004).Production of Floral Dyes from Different Flowers Available inWest Bangal for Textiles and Dyeing Industry.<http;//www.chemca 2007.com.>.

Shariff,A. (2010).“Extraction Of Natural Colorants From Onion (A) Skin Using Pressurized Liquid Extraction For Application In Fabric Dyeing”. Universal Journal of Environmental Research and Technology.vol.1. 2011.

Zomoh, M.I. &Okoror, L.E. (2010).An Answer to Africa’s Greatest Needs in One Tree(locust Beans).

Zhong, Y.C., M.Sun and H .Clarke, (2005).“Characterization and Application of Betalain Pigments from Plants of the AmaranthaleaeTrends of Food Science Technology”, 16; 370—376.Asian Journal of Applied Sciences, 2010.