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Marigold Petals (Tagetes Erecta) & Onion Peels (Allium Cepa) Natural Dyeing on Cotton Fabric by using Cowdung (Bovine Faeces or Manure) Mordant

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Abstract: ***The present research study deals with the Natural Dyeing on cotton. Natural dyes were used for colouring of textiles from ancient times till the nineteen Century. The usage of natural dyes decreased with the invention of synthetic dyes in 1856 by Perkin. So, some of the synthetic dyes are harmful, synthetic dyes have adverse effects on nature and human body. Use of the natural dyes is restricted in view of some of their disadvantages with less availability, poor colour yield, reproducibility of shade, inadequate fixation and fastness. The main concern is to protect the environment from any damage and to reduce damages that are prevalent in the existing practices. It is important to use substances that do not harm the environment. Environmentally awakened consumers prefer textiles coloured with natural dyes and today there is a niche market for such naturally dyed textiles. This study was undertaken to explore possibilities of arriving of naturally dyed cotton fabric as sustainable yields with natural source like Marigold flower and Onion Peels and natural mordant as Cow dung. The natural dye was extracted at 30%, 40% and 50% shade used to dye cotton fabric using natural mordant. The mordant considered in this research is cow dung at 5% concentration. Cotton fabric were dyed with three different mordanting such as pre - mordanting, simultaneous - mordanting, post - mordanting with exhaust method. A wide range of colours were obtained using the various dyes and also gave light yellow, beige, dark yellow, golden yellow, reddish colours are obtained. The dyed fabric samples were then tested for the different fastness properties such as wash, rub, perspiration and light fastness. The results that indicated are run fastness for both dry and wet test showed excellent to good result and the perspiration fastness for both acid and alkaline showed good result. But the colour fastness to washing gave good to poor result when the study was carried out. So it is concluded that cow dung mordant showed good result on cotton fabric and it can used for any dyes. Naturally dyed and herbal treated fabrics have many benefits in addition to their concerns towards environment sustainability being rather nontoxic and eco - friendly in comparison to synthetic dyes and chemicals.***

Keywords: Mordant as Cow dung, Marigold flower, Onion Peels, Cotton fabric, Qualitative analysis, fastness properties

1. Introduction

1.1 Cotton (Substrate)

The textile industry is one of the largest in India, occupying a vital place in the Indian economy. Textile exports from nearly 30% of India's total textile industry continues to be predominantly cotton based, with about 65% of raw materials consumed being accounted for by cotton.

The word cotton derived from the Arabic word 'quoton' or 'qutun' which means a plant found in conquered lands. Cotton is the principal clothing fibre not only of India, but also of the five continents of the world and accounts for more than 50% of clothing, household and industrial applications. Although, since the 2nd World War cotton has been under severe pressure from man made fibres, the king of fibres for over 5000 centuries is still reigning supreme.

India is the original home of cotton, and its exquisite cotton textile has a pride of place throughout the world in the past. The finest yarn was manufactured from an unknown cotton variety in Assam during last years of Mughal rule and a 10sq. m. fabric which could cover a common elephant, could pass through an ordinary ring. As a matter of fact, till the end of the 18th century, no source of supply of cotton other than India was known to the world.

As far back as history records, cotton has been used the year round, the world over. India is usually credited with developing the first cotton fabric. the cotton grew wild and natives called it 'tree wool'. From colonial times, the United States has been the world's leading cotton grower. India, China and Russia are the other major cotton producing countries.

It was the cotton textile industry, which laid the foundation of industrialization in India. Even though man - made fibres have over taken natural fibres, the world production of cotton is still greater than all other fibres combined. King cotton still dominates 53% of the world fibre market.

1.1.2 Structure of cotton

Cotton is the seed hair of plants of the genus Gossypium. Many species are frown for commercial use, but they may be conventionally divided into three types:

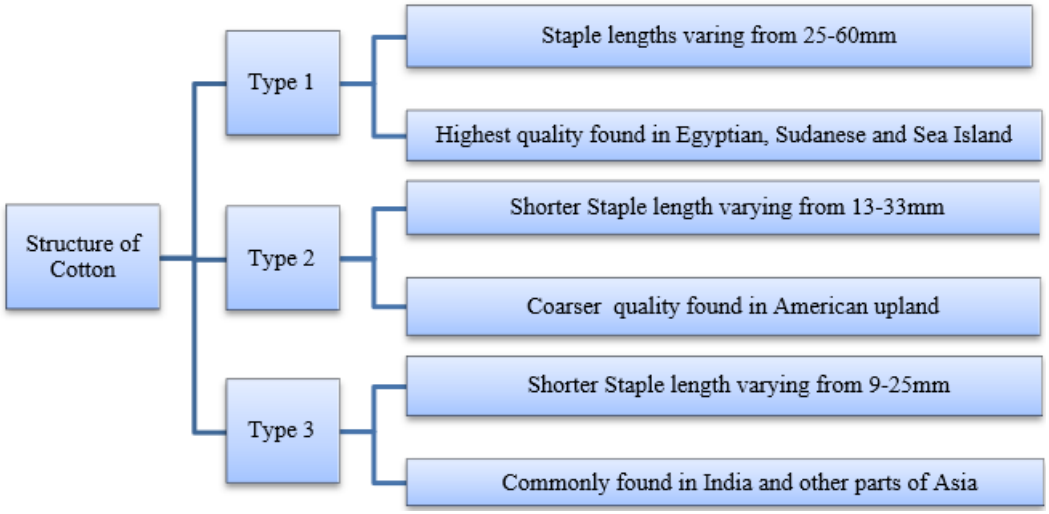

Figure 1.1.2: Structure of cotton

The mature cotton fibre forms a flat ribbon varying between 12 and 20 micro meter in width. It is highly convoluted, probably on account of the twisting that takes place when the tubular shape that is possesses during growth collapses as the fibre dries out. The number of convolutions varies between 4 and 6 per mm and they reverse their direction every millimetre or so along fibre.

Chemically the fibre contains about 90% cellulose and about 6% of moisture, the remainder consists of natural impurities. Each cotton fibre consist of three main parts; primary wall, secondary wall and lumen. The primary wall consists of a network of cellulose fibrils covered with an outer layer or cuticle, of pectin, protein, mineral matter and wax. It is the wax that renders the fibre impermeable to water and aqueous solutions unless a wetting agent is present. The secondary wall constitutes the bulk of a mature fibre and consists almost entirely of fibrils of cellulose arranged spirally around the fibre axis, the direction of the spiral reversing (i. e changing from S to Z twist and vice versa) many times along a single fibril. The secondary wall consists of several layers and the spiral angle of the fibrils varies from one layer to the next. Thus the cotton fibre consists of an assembly of fibrils in which the cellulose is accessible to most chemical reagents only at fibrillar surfaces by way of a system of voids and channels. The lumen is what remains of the central canal from which the layers of cellulose were laid down in the secondary wall while the fibre was growing. It contains some residual proteins.

1.1.3 Properties and uses of cotton

The usefulness of cotton is dependent upon its characteristics. Chemically cotton is made up of long chains of cellulose. It is possible to change the characteristics of cotton by having chemicals react with the cellulose. Chemicals can also be added to the surface of the cotton fibre to mask or change its basic characteristics.

The physical properties of cotton are shown below:

Table 1.1.3: Physical Properties of cotton

1) Shape	Fairly uniform in width, 12 - 20 microns Length, variable from 0.5 - 2.5 inches.
2) Luster	Low
3) Strength	3 - 5 g/denier, medium strength
4) Elastic recovery & Elongation	Low elasticity, elongation 3 - 7 %
5) Resiliency	Low
6) Specific gravity	1.54
7) Moisture absorption	8.5% at standard conditions, 15 - 25% at saturation
8) Dimensional stability	Considered relatively stable

Cotton fibre is very strong and depending upon the type of fabric into which it is made is very durable. It is not fair. However, to compare a strong fabric like denim which is designed for rugged ware, with a sheer, light weight voil which is designed for beauty and drape. Cotton is easily cared for, since it thrives on soap and water washes. It is stronger when wet than dry.

1.2 Natural Dyes

The use of natural dyes for textile dyeing purposes, decreased to a large extent after the discovery of synthetic dyes in 1856. As a result, with a distinct lowering in synthetic dye stuff costs, the natural dyes were virtually unused at the beginning of twenties century (Purrohit, 2011). Presently there is an excessive use of synthetic dyes, estimated at around 10, 000, 000 tons per annum, the production and application of which release vast amount of waste and unfixed colorants causing serious health hazards and disturbing the eco - balance of nature (Goodarzian, 2010). Nowadays, fortunately, there is increasing awareness among people towards natural dyes. Natural dyes have better biodegradability and generally have higher compatibility with the environment. They are non - toxic, non - allergic to skin, non - carcinogenic, easily available and renewable (Kulkarni, 2011).
Source: (http: //www.environmentaljournal. org/1 - 3/ujert - 1 - 3 - 6. pdf)

Natural dyes have been in use since times immemorial and continue to fascinate mankind with their long endurance and soft lustrous colouring. It is difficult to tell when exactly people started to make colour. Colour is an element which transforms the entire fabric of life. Perhaps, the knowledge and use of colours began with the dawn of civilization, but the art of extraction and the use of colour was discovered and perfected in India. Every individual has her his own choice and liking for colour. Whether it is the icy appearance of the Himalayan ranges or the evergreen forests or fields of

agricultural produce or trees laden with colourful ripe fruits or the butterfly moving from one flower to another. generation after generation have been being attracted. A beautiful fascinating colour is anybody's choice selection. Not content with enjoying colour through his eyes, man wanted to feel and sense it intimately and thus began personal adornment. Colour was associated with seasons, festivals, emotions and human qualities. Because of their non - toxic effects. natural dyes were not only used in clothing but were intensively used in cosmetics, pharmaceutical industries and food industries (Srivastava, 1989; Dawson, 2006; Mishra et al., 2010; Singh and Purohit, 2012). e. g. the colouring of candy by the Egyptians and the colouring of wine date back to as long ago as 400 B. C. (Downham & Collins, 2000). The ability of natural dyes to colour textile has been known as early as 3000 B. C. (Guinot et al. .2006).

Source: (http: //shodhganga. inflibnet. ac. in/bitstream/10603/180678/9/07%20chapter%201. pdf)

1.2.1 Sources of natural dyes

Natural dyes basically comprises colourant from vegetables resources like roots, stems, shrubs, barks, leaves, seeds and flowers of plants and trees. From very ancient time, the mastery of extraction of these dyes from natural resources is well known in India as most of these natural materials used in Ayurvedic preparations. These plants are distributed in various regions of our country. About 500 available plant resources in India are listed in a statistical data which can be used for fabric dyeing.

1.2.3 Fabric used to make natural dyeing

Most common fabric used is organic cotton, the cotton which is cultivated without chemical pesticides and fertilizers. Silk, wool, coir, linen, hemp banana, nettle, bamboo etc. were too used.

1.3 Mordants

Natural dyes can either be applied directly on to the fabric or needs a chemical in the form of metallic salts to create an affinity between fibre and the pigment. These chemicals are known as mordants. These name is derived from latin word “moder” which means “to bite”. The metallic salts are corrosive in nature that made textiles rough, opened their pores and hence colouring matter can easily get fixated on to the substrate. Certain dyestuffs with no affinity for the fibre, are fixed on to the fibre due of the link formed between dyestuff and fibre. It is also helps to produce faster shade of the dyes, which can directly be applied by forming an insoluble compound of matellic salt and dyestuff with in the fibre.

There are three types of mordants:

a) Metal salts or metallic mordants.
b) Tannins and tannic acid.
c) Oils or oil mordants.

Metallic mordants are produced from natural sources or it may be metal salts of aluminium, chromium, iron, copper and tin. Some of the common metallic mordants are: alum, potassium dichromate, ferrous sulphate, copper sulphate, stannous chloride and stannic chloride.

Tannins occurred in the extractions in the bark and other parts like leaves. Fruits and galls. Myrabolan and sumach are the most important tannins. Tannic acid is found in most of the tanic containing substances especially in nutgalls and in sumach.

Oil mordants are generally used in the dyeing of Turkey red color from madder. The main function of the oil mordant is to form complex with metal salts.

1.3.1 Methods of application

Three commonly used mordanting methods are listed below. They can be used in isolation or in association with each other to get desirable results.

- **Pre - mordanting** – Textile substrate is treated with mordant, this treated fabric is then taken in for dyeing.
- **Simultaneous mordanting** – The fabric is mordanted and dyed at the same time. The dye bath contains both the dye stuff and mordant together in the same dye liquor.
- **Post - mordanting** – The dyed fabric is then mordanted for suitable time.

1.3.2 Comparison between herbal and chemical dyeing process (Kumar, 2014)

Table 1.3.2. Herbal and chemical dyeing process

S. no	Process	Herbal dyeing process	Chemical dyeing process
1	Bleaching	Cow Dung, Minerals	Hydrogen peroxide (H_2O_2), Sodium hypochlorite (NaOCl), Chlorine (Cl_2) etc.
2	Scouring	Sea Salts, Sunlight	Caustic soda (NaOH)
3	Mercerizing	Minerals, Oils	Caustic soda (NaOH), Acetic acid (CH3COOH)
4	Dyeing	Medicinal Herbs	Dyes, Soda ash (Na_2CO_3), Caustic soda (NaOH), Sodium chloride (NaCl) / Glauber salt, Soap etc.
5	Dye fixing	Natural Oils	Formaldehyde (HCHO)
6	Finishing	Rolls, Sugar, Oils	Chemicals
7	Washing	Rita, Khar, Natural Soaps	Detergent

Source: https: //www.researchgate. net/publication/282455304

1.4 Cowdung Mordant used for Research Purpose

The increased interest in natural plant dyes a greater importance was given to using mordant. Most of the natural dyes require some sort of mordant to set permanently in any fiber. Metal ions of mordants act as electron acceptors for electron donors to form coordination bonds with the dye molecules, making them insoluble in water. This leads to improve dye uptake and retention, which result in a greater depth of shade and color fastness properties. Common mordants are alum, chrome, stannous chloride, copper sulphate, ferrous sulphate, and so forth. Chrome and copper are considered to be harmful for human skin as objectionable heavy metals beyond a certain limit of their presence. Organic

substances that have been used as mordants are mud, blood, and cow dung. Also to reduce the effect of some toxic mordants, natural mordants such as tannins are recommended, as they can provide fabrics with characteristics similar to those provided by synthetic mordants.

1.4.1. Benefits of Cowdung

- Cow dung, which is usually a dark brown color is often used as manure (agricultural fertilizer). If not recycled into the soil by species such as earthworms and dung beetles, cow dung can dry out and remain on the pasture, creating an area of grazing land which is unpalatable to livestock.
- In many parts of the developing world, and in the past in mountain regions of Europe, caked and dried cow dung is used as fuel.
- Dung may also be collected and used to produce biogas to generate electricity and heat. The gas is rich in methane and is used in rural areas of India and Pakistan and elsewhere to provide a renewable and stable source of electricity.
- Cow dung is also used in Hindu religious fire yajna as an important ingredient.
- Cow dung is also used in the making of panchgavya, for use in Hindu rituals.
- It is also used as a medicine in India.
- Cow dung provides food for a wide range of animal and fungus species, which break it down and recycle it into the food chain and into the soil.

Figure 1.4.1: Cowdung
https: //www.google.
com/search?q=benefits+of+cowdung&source=lnms&tbm=isch&sa=X&ved=0ahUKEwi6lIPsiNnhAhUxmeYKHRgiBl0Q_AUIDigB&biw=1366&bih=608#imgdii=YDLk5ijroAINPM: &imgrc=PHWobln3kQ5d4M:

1.5 Natural Dyes used for Research Purpose

1.5.1 Marigold Petals (Tagetes erecta)

Marigold is a plant of the genus Tagetes of the family Asteraceae, mostly cultivated as garden flower that is one of the natural sources for achieving yellow color. Marigolds were well known and valued by ancient people in South Asia. Their golden colour was considered to resemble the colour of the Arya, or honourable people. It was used to demarcate special spaces like pavilions and to line sacred fire - pits or kunds in which ceremonies were performed. Currently, Marigold plants are grown for pigment production in Mexico, Peru, and India. From decoration to dyes, brightly coloured yellow and orange Marigolds provide familiar splashes of colour in South Asia. They are mainly used to make garlands and for adorning buildings and statues of spiritual significance but have also been used to make skin creams. In Britain, Marigold planted by gardeners to discourage pests. The essential oil from the leaves of this flower has been reported to have some anti - fungal and insecticidal properties. Marigold flowers are used at many religious ceremonies and festivals. Strung together they make colourful garlands and are used as offerings and to decorate religious buildings and statues. The petals are used in South Asia to dye fabrics and wool yarns. Marigold plants are stout and branching and can grow up to 60 cm tall. Leaves of Marigold are dark green in colour and are strongly scented. Flowers vary in colour from yellow and gold to orange, red and mahogany. The taller and larger - flowered Tagetes erecta was often called African Marigold and the smaller Tagetes patula was known as French Marigold. But Marigolds have been cultivated all over the world and lots of similar hybrid varieties have been developed from the two species. Marigold flowers contain compounds called carotenoids. Lutein (C40H56O2) is a natural pigment of the carotenoid family. It is widely found in nature. Lutein and its isomer zeaxanthin also known as oxycarotenoids. They are the main xanthophylls in Marigold flowers and also in vegetables such as spinach and kale. It is also present in foods such as corn and egg yolks and can be found in the eye, skin, cervix and the breast. It is a powerful antioxidant and helps in maintaining healthy eyes.

Source: https: //www.researchgate. net/publication/225100000_Dyeing_of_wool_with_Marigold_and_its_properties

Marigolds are hardy, annual plants and are great plants for cheering up any garden. Broadly, there are two genuses which are referred to by the common name, Marigolds viz. Tagetes and Celandula. Tagetes includes African Marigolds and French Marigolds. Celandula includes Pot Marigolds.

Marigolds come in different colors, yellow and orange being the most common. Most of the marigolds have strong, pungent odor and have great value in cosmetic treatment. There are many varieties of Marigolds available today.

- **Common names**: Marigold
- **Indian names**: Genda/Gainda (Hindi), Chenna Mallige/ Chandu Mallige (Kannada)
- **Botanical Name**: Tagetes erecta
- **Varieties**: African/American Marigolds, French Marigolds, Rock Garden Marigolds
- **Design Ideas**: flower beds, suitable for growing in containers.

Source: https: //www.greenmylife. in/growing - marigolds/

Figure 1.5.1: Marigold Petals (Tagetes erecta)
https: //www.google.
com/search?q=marigold+flower+picture&tbm=isch&source=iu&ictx=1&fir=tQKkbEQcymueGM%253A%252CmGRo_AlV cmqKpM%252C_&vet=1&usg=AI4_ - kQ6Cve_0p1x_Z6ss5duUncCR - 2RQQ&sa=X&ved=2ahUKEwiRufKcvu3hAhU36XMBHRqPCWkQ9QEwAXoECAYQBg#imgrc=tQKkbEQcymueGM: &vet=1

1.6.2 Onion Peels (Allium cepa)

Onions (allium cepa) also known as bulb onions which is vegetable used in preparing food and widely cultivated around the world. Most onions cultivated are about 89% water, 4% sugar, 1% protein, 2% fiber. Onions also contains vitamins which include Vitamin B1, Vitamin B2, Vitamin B3, and Vitamin C, it also contains compounds such as phenolics and flavonoids as well as elements like iron, calcium, magnesium, manganese, and zinc. The skin of onions is inedible however it contains a dyestuff called "Pelargonidin". (Zubairu & Mshelia, M, Y.2015)

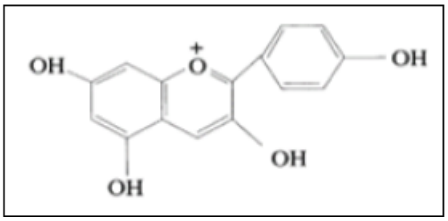

Figure 1.5.2.1: Structure of "Pelargonidin" (3, 5, 7, 4 tetrahydroxyl antocyanidol –a Dye stuff in onion skin
Source: http: //article. sapub. org/10.5923. j. scit.20150502.02. html

Onions (Allium cepa) possess strong characteristic aromas and flavors, which have made them important ingredients in food (Ly et al.2005). It has been shown that bioactive compounds are present in every part of onion bulb (Benitez et al.2011). Onion is a potent cardiovascular and anticancer agent, with hypocholesterolemic, antioxidant, antiasthmatic, and antithrombotic activity (Moreno et al.2006). Onion is one of the major sources of dietary flavonoids which contains anthocyanins, that is responsible for the red or purple color observed in some varieties, and flavonols (quercetin) that may contribute to the production of yellow and brown compounds found in the skins of many onions. Quercetin has demonstrated antioxidant and free radical scavenging power and its capability to protect against cardiovascular disease (Bonaccorsi et al.2008, Benítez et al.2011). However, onion skins contain higher concentrations of quercetin aglycon than the flesh (Downes et al.2009).

Source: http: //ijsrm. humanjournals. com/wp - content/uploads/2017/11/3. Beatrice - O. - T. - Ifesan. pdf

Figure 1.5.2.2: Onion Peels (Allium cepa)
https: //www.google.
com/search?ei=zdTCXNGeHrfSz7sPmp6myAY&q=onion+ peels+picture&oq=onion+peels+picture&gs_l=psy - ab.3. .0i67l2j0i20i263j0i7i30l7.5126.10942. .11195. . .0.0. .0.462.3932.2 - 2j1j7. . . . . .0. . . .1. . gws - wiz. 0i71. AQJk2L0uODU

1.6 Advantages of Natural dyes:

There are some advantages properties of natural dyes, which are given below:

- They are procured from renewable resources.
- They can be obtained from waste such as wild weeds, naturally fallen flowers, branches, leafs and fruits that are non - edible, plant parts remaining after extraction etc.
- They exhibit lower toxicity and allergic reaction as compared to synthetic dyes.
- Sometimes they act as health cure.
- Practically no or mild chemical reactions are involved in their preparation.
- No disposal problem.
- They are unsophisticated and harmonized with nature.
- Natural dyes exhibit better biodegradability and generally have a better compatibility with the environment.
- Dyeing with natural dyes is one of our heritages, which is rich, novel and beautiful.
- Reduction of the import of chemicals and thus saving the net earnings of foreign currency.
- Generation of more employment opportunities for the rural people.
- Lot of creativity is required to use these dyes judiciously.

1.7 Limitation of Natural Dyes

The limitation of the natural dyes, which were responsible for their decline, is:

- Lesser availability
- Lesser color yield
- Complicated dyeing process
- Limitated number of suitable dyes
- Allow only wool, natural silk, linen and cotton to be dyed
- Non - standardized
- Inadequate degree of fixation and exhaustion
- Effluent problem
- Impact on land utilization
- Difficulty in blending dyes
- Difficulty in dyeing synthetic fibres with natural dyes

2. Review of Literature

2.1 Natural dyeing

Many experiments have been conducted to show the effectiveness of Natural Dyeing. It was found through various trials that such an environment can help those suffering from skin diseases, arthritis, eczema, psoriasis and rheumatism and blood pressure. All these trials showed a "marked improvement" (Krishnan, 2007; Srinivasan, 2010)

- Devi Rajeswari V, (2015): Nature has gifted us with more than 500 dye - yielding plants. One such dye–yielding plant species is Tageteserecta L., commonly known as Mexican Marigold because of its origin. This research was performed with the explicit objective of extracting natural dye from the petals of Mexican marigold flower using different solvents such as Methanol, Ethanol, Hexane and Water, and to investigate its dyeing effects on different fabrics and yarn samples. The effects of various mordants on the stability of the dye as well as on the color shade were also analyzed. The color shade differences, L*, a*, b*, ΔE values and K/S values were estimated via CCM software analysis tool using GretagMacbath 7000 A ° spectrophotometer. Light fastness, Wash fastness and Rubbing fastness were also evaluated for fabrics and yarn samples. The dyed material was tested for wash fastness, light fastness, and rubbing fastness. The color is usually rated by loss of depth of color in original sample. The required condition for the tests is specified in different standard including International Organization for standardization (ISO) and the American Association of Textile Chemists and Colorists (ATCC). ISO 105 B02: 1994 Amd: 2000, AATCC TM 61 - 2010, ISO 105 X12: 2001 were used for light fastness, wash fastness and rubbing fastness respectively.
- Source: https: //www.researchgate. net/publication/281571875_Improving_the_colour_fastn ess_of_the_selected_natural_dyes_on_cotton
- Bahal Deepti (1994): Carried out some studies on natural dyes. This is to attempt to study in details, the mechanism of dyeing various textiles material with natural dyes: to standardize a method for separation and purification of colored compunds present in a selected plant material and to characterize and identify them to comprehensively review natural dyes and their fastness properties. Further to test and document the fastness properties of some prominent Indian dyes and to study the kinetics of light fading of particular dye lawsone (a coloring compound in Henna leaves)
- Dr. Vishwanathan: The study was carried out to check the patients who suffering from skin diseases by using the synthetic dyed fabric. The Dravyaguna Department (Ayurveda Pharmacology Department) of Government ayurveda College conducted a month - long trial by using Natural dyed bedding, rugs and towels made from Ayurvastra and they found that it helped the patients who suffered from diseases like eczema, psoriasis and rheumatism. According to the former Dean of the Drug Research Department at Ayurveda College, "they treated around 40 people. And the response was remarkably good, especially in cases of arthritis and skin ailments. "
- M P Sathianarayan, N V Bhat, S S Kokate and V E Walunj: It has shown that recent market survey has quite convincingly shown that the apparel consumers all over the world are demanding functionality in the product. Some of the best examples of functionality are product attributes such as wrinkle resistance, soil release, water repellency, flame retardancy, fade resistance and resistance to microbial invasion. Among these the Antimicrobial property of fabric is being considered to be an important and inevitable parameter of garments which are in direct contact with human body.
- Gulrajani & Gupta, (1990): Natural dyes are the dyes and pigments obtained from renewable resources of nature, such as plant and animal, although natural dyes from minerals of the earth also known. Colouring matter derived from different organs of plant, such as root, leaf bark, trunk or fruit known as vegetable dyes. Colouring matter obtained from various inorganic metal ores and metal salts as mineral dyes.
- Jothi (2008): Conducted study on African marigold, a major source of carotenoids and lutein, is grown as a cut flower and garden flower, in addition to being grown for its medicinal values, Marigold flowers, which are yellow to orange red in colour, are a rich source of lutein, a carotenoid pigment. Nowadays, Lutein is becoming an increasingly popular active ingredient used in the food industry and textile colouration. This pigment has acquired greater significance because of its excellent colour value. Results reveal that the extract of Marigold flower can used for colouration of 100% cotton, silk and wool fabrics. This article deals with the chemistry, processing and stability of the pigment and its applications in the textile colouration.
- Mohammad Gias Uddin, (2014): At present, a higher demand is put towards the use of natural dyes due to increased awareness of the environmental and health hazards associated with the synthesis and use of synthetic dyes. This research was conducted using onion outer skins as a potential source of natural plant dyes. In this study, extraction of dye was carried out in aqueous boiling method. Pre - mordanting technique was followed using different mordants, namely alum, ferrous sulphate, tin, tannic acid, tartaric acid, and their combinations on silk fabric. Fabric samples dyed without using any mordant were then compared with the dyed samples pre - treated with the mordants. The range of colors developed on dyed materials was evaluated by measuring the color values with respect to K/S values and color coordinates. It was concluded that the color values were found to be influenced by the addition of mordants, and thus different fashion hues were obtained from the same amount of dye

extract using different mordants. Ferrous sulphate was found as the most influential mordant. Ecmc values between unmordanted (Reference dyed) and metallic mordanted fabric samples were found higher than those between unmordanted and non - metallic mordanted fabric samples. The dyed samples were evaluated for color fastness to washing, light, dry cleaning, rubbing, and perspiration. The color fastness properties were found to be satisfactory and improved in many cases. From the fastness results, it was obvious that these dyes can also be applied on silk fabric without using any mordant if required.

- R, Prabhavathi. et. al, (2014): Improving the colourfastness of the natural dye with dye fixing agents, extraction of the colourants from natural sources; effects of different mordants and mordanting methods; selection of fixing agents; dyeing variables; post - treatment process; development of newer shades with post treatment and analysis of colour improvement parameters with fixing agents for cotton dyed with natural dye; assessed colour improvement with colourfastness test.
- Prabhavathi, Sharada Devi & Anitha: In this article how to improve the colour fastness properties of natural dyes with 5 dye fixing agents. Eco - friendly mordants such as alum, stannous chloride and ferrous sulphate are used. Annato dye is selected because this source produces fugitive colours on cotton. A pre - treatment with myrobalan has been given for better dye uptake. After dyeing, the sample is post treated with 5 dye fixing agents such as alum, ammonia, lime juice and calcium chloride for better colourfastness of natural dyes on cotton. The dye extraction and treating procedures are standardized based on the procedures suggested by AICRP - Home science (1997). Treatment was given to the cotton samples and evaluation of treated samples in terms of colour fastness to washing, before and after treatment was undertaken by following the standard procedures laid down by Bureau of India Standard Test Series IS 768 - 1956 for colour change. The result is 769 - 1956 for staining using geometric grey scale. The results were analyzed based on the colour fastness of control samples to find out the impact of the treatments. Alkaline method is suitable for extraction of dye from Annato. The optimum time for extraction of dye liquor from the seeds was 60 minutes. A dye material concentration of 4 percent (2g/g of fabric) was selected. The optimum time for dyeing was 45 minutes for both the dyes. Cotton fabric was pre - treated with 20 per cent myrobalan concentration to 9 increase the tannin deposition which in turn increased the depth of the shade obtained. Natural dyes have emerged as prime colorants for textiles globally. Very few studies have been conducted to improve the colourfastness of these natural dye sources. Therefore, an attempt has been made in this study to improve the colour fastness of natural dye source i. e. annatto seeds by using five fixing agents.
- Faqeer Mohammad, (2016): Natural dyes have acquired tremendous commercial potential as some of the synthetic dyes are associated with the release of enormous amount of hazardous chemicals into the environment (Yusuf et al.2013, 2015). The revival of interest in the use of natural dyes in textile coloration has been gaining incessant popularity all over the world, probably due to environmental concerns, eco - safety, and pollution control. Natural dyes are supposed to be friendlier and exhibit better biodegradability to the environment than their synthetic counterparts (Yusuf et al.2015; Shabbir et al.2016a, b). Reproducibility, inadequate availability, cost efficiency, inadequate degree of fixation, and poor color fastness properties are common discernable drawbacks of natural dyes (Cristea and Vilarem 2006; Hill 1997; Khan et al., 2012). In addition, dyes and pigments of natural origin also possess biological and biomedical activities, so they may serve as a green alternative towards synthetic dyes.

3. Purpose of the Study

3.1 Rationale

Renewable use of the natural dyes on textiles has been just one of the consequences of increased environment related awareness. The synthetic dyestuffs have come under severe criticism as they are highly polluting during the manufacturing as well as use. Natural dyes could be an alternative as they are supposed to be either non - toxic or less toxic than synthetic dyes. Further they have better biodegradability and lower allergic reactions.

One of the biggest limitations of natural dyes is the availability of limited shade. To overcome these limitations, much of the R & D is being carried out to extract the natural dyes from more and more different unknown sources and expand the range of shades available from natural dyes and to study the related aspects such as fastness properties etc.

3.2 Broad Aim

To study the effect of cowdung as a mordant on cotton fabric dyed with Natural dye like Marigold flower and Onion peel comparing its fastness properties with natural dyed fabric using water.

3.3 Objectives of the study

- To assess the dyeability of Cotton using Marigold Petals and Onion Peels as the source of colour extracted with regards to development of shades, fastness properties (wash, rub, light and perspiration) using Cowdung as mordanting technique of pre - , simultaneous and post - mordanting and using the percentage shade (30%, 40%, 50%), and Material to liquor ratio of 1: 30, pH (5.5), temperature 90oC, time (45 min) for dyeing
- To compare and contrast the results of the above tests and to arrive at the optimum process parameters thereby standardizing the application procedure.

4. Methodology

4.1 Experimental raw materials

4.1.1 Raw material

- 100% Cotton Fabric: 2.5 meters plain woven
- Marigold flower from the near by local market: 1 kg (60rs/ -)
- Onion peels from the local market
- Cowdung from the village (Karad): 500 grams

4.2 Experimental Procedures

4.2.1 Pilot Study

Pilot testing was carried out on 20 x 20 cm cotton fabric. Dyeing was done with natural source such as Marigold by 10% 20% shade by extraction method and using cowdung as mordant. Fabric was uniformly dyed and the samples resulted in light yellow and yellowish shades. Pre - mordanting and post - mordanting was experimented on trial samples. So, the colour dyed with the extraction method did not get positive results. Hence the further study was continued with the exhaust method to get better results and darker colour shades.

4.2.2 Fabric Pre - treatment

4.2.2. Scouring

Scouring was done for removal of natural and added impurities. The fabric was weighed and wetted out prior to impregnating in scouring bath. The fabric was squeezed thoroughly and was scoured in a solution containing Salt at boiling temperature (100^0C) for 45 min with material to liquor ratio 1: 40, rinsed thoroughly to remove any residue and dried in shade (Yadav, 2006)

4.2.3 Preparation for Mordanting of cotton fabric:

- Pre - Mordanting – The fabric is treated with 5% mordant solution with MLR =1: 30 at 100^0 C for 45 minutes and then transfer to the dye bath without rinsing.
- Simultaneous - Mordanting – The fabric is treated with 5% mordant solution and dye simultaneously with MLR =1: 30 at 90^0 C for 45minutes.
- Post - Mordanting - The fabric is treated with dyeing and then transfer to 5% mordant solution with MLR =1: 30 at 90^0 C for 45 minutes.

4.2.4 Preparation of Dye Liquor

- 100 ml of water was measured.
- 20gms of marigold powder and Onion powder was added at room temperature.
- Boiled and reduced to ½ extraction by using exhaust method.
- Filtered to remove powder.
- MLR calculated as 1: 30.

4.2.5 Dyeing Procedure

Fabric was immersed in dye liquor at room temperature and boiled at 90ºC.

Dyeing continued for 45 minutes, 20 x 20 cm sample of cotton was taken and weighed. The dye liquor for dyeing was prepared using the extracted stock solution with an MLR of 1: 30. There was three solutions 30%, 40% and 50% according to the shades planned for the samples. The fabric was first wetted and immersed into the dye liquor. The dyeing continued at 90^0C. The process continued for 45 minutes. After which the samples was rinsed in running water.

- **Step A: Experimenting with Pre mordanting –** First the fabric was treated with mordant, and then this treated fabric is taken for dyeing.
- **Step B: Experimenting with Simultaneous mordanting –** The fabric is mordanted and dyed at the same time. The dye bath contains both the dye stuff and mordant together in the same dye liquor.
- **Step C: Experimenting with Post - mordanting –** The dyed fabric is then mordanted for suitable time.

4.2.6 Soaping

The dyed samples were washed with 2 grams of non - ionic detergent per litre of water at 60ºC for 15min with MLR = 1: 40 followed by rinsing and drying.

4.3 Qualitative Analysis

Standard: Development in 1995 by AATCC Committee RA 24

For Qualitative analysis of the fabric, various test are carried out were burning test, microscopic test and solubility test.

4.3.1 Burning test:

The burning test was conducted to identify the nature of the fiber and to know the group to which they belong. Various characteristics like approaching flame, in the flame, away from the flame, odour and residue were observed, evaluated and result is noted.

4.3.2 Microscopic test:

The microscopic test was conducted to study the structure and characteristics of fiber under the microscopic. The longitudinal section of fiber was observed and noted.

4.3.3 Chemical Solubility:

The chemical solubility was conducted to study the characteristics reaction of fiber through various chemical treatments to identify and differentiate them. Various characteristics like effects of acids, alkali, bleaches and solvent were observed, evaluated and noted.

4.4 Testing

Qualitative Analysis

Development in 1995 by AATCC Committee RA 24

Aim:

To identify the fiber present in the sample Burning test, Microscopic test and Chemical solubility test.

Apparatus:

Microscope, Cover slip, slide, forceps, blotting paper, beaker with water, gas, burner, solutions, match box, glass rod and fabric sample.

1) Burning Test

Procedure:

a) Take 1 or 2 yarns of the fabric.
b) Untwist the yarn so that they form a loose mass.
c) Hold the loosen fibers in the forceps and move them towards the flame from one side.
d) Observe their properties while,
   - Approach the flame.
   - In the flame
   - Away from the flame
   - Odour
   - Residue

2) Microscopic Test

Procedure:

- A yarn from the given sample was unravelled and one or more fiber was pulled out.
- A drop of water was put on the glass slide using a power microscope.
- The general structure of the fiber was noted under the microscope.

3) Chemical Solubility Test

Procedure:

a) The specimen to be tested is placed in 3 - 5ml solution of the reagent in a test tube at room temperature.
b) The specimen is stirred with a glass rod allowing it to send for 5 - 10 minutes for the rest to be complete.
c) Observed aspects of the sample are checked:
   - The sample was completely soluble.
   - The sample was partially soluble that is it disintegrates and dissolves.
   - The sample was in soluble.

Annexure 9.2

Dyeing with Natural Dyes

Aim: To dye fabric with cowdung and natural dye which is obtained from herbs and natural mordant.

Material: Cotton fabric, Cowdung, Marigold Petals, Onion piles, Measuring cylinder, Muslin cloth, Gloves, Match box

Procedure:

Pre - Mordanting: The fabric is treated with 3% Mordant solution with MLR = 1: 30 at 90ºC for 30 minutes and then transfer to the dye bath without rinsing.

Simultaneous - Mordanting: The fabric is treated with 3% Mordant solution and Dye bath solution with MLR = 1: 30 at 90ºC for 30 minutes.

Post - Mordanting: The fabric is treated with Dye bath solution with MLR = 1: 30 at 90ºC for 30 minutes and then transfer to the 3% Mordant solution without rinsing.

Dyeing:

- Dyes were extracted from herbs like marigold patels and onion peels with an MLR od 1: 30
- Dyeing was done by using 30%, 40%, 50% shade
- MLR (Material to Liquor Ratio) = 1: 30
- The dye bath temperature was raised to 90ºC and then dye extract was added to it
- The mordanted fabric was then immersed into the dye bath solution and temperature was raised to 90ºC
- Time required: 30 minutes
- The sample was squeezed and washed with cold water
- After washing soaping is done to remove excess dye
- Then samples are rinsed thoroughly and dried

Annexure 9.3

Colour Fastness to Washing:

Standard Test No. /Method: ISO 105 C10

Aim: To determine the colour fastness of the given sample to washing.

Material: Dyed sample, Soap, Grey scale, Launder - o - meter, White fabric, Soap solution

Procedure:

1) The dyed sample to be treated are cut to a size of 10X5cms and sandwiched between two adjacent pieces of same dimensions.
2) Test specimen is prepared by sewing the three layers of the fabric together. The test specimen is weighed and soap solution is prepared using MLR 1: 20
3) The required solution and the sample are kept in the launder - o - meter at 60ºC temperature for 45minutes.
4) The sample is then removed and rinsed in water
5) The stitches are opened from 3 sides and the sample is allowed to dry at room temperature.
6) The test specimen is evaluated using grey scale for assessing changes in colour and extent of staining.
7) The results are noted for the test specimen.

Figure 9.3: Launder - o - meter

Annexure 9.4

Colour fastness to Light:

Standard Test No. /Method: AATCC - RR 92 2013

Aim: To determine the Colour Fastness of given sample to light.

Material: Dyed sample, grey scale, light fastness tester (MBTL)

Procedure:

1) The test specimen was cut into 5x10cm sample size.
2) The test specimen samples were mounted.
3) The test specimen was exposed to the white light for 4 hours temperature.
4) Then test specimen was removed.
5) The test specimen was evaluated with grey scale Standard for colour change.

Figure 9.4: Light Fastness Tester (MBTL)

Annexure 9.5
Colour Fastness to Rubbing:
Standard Test No. /Method: ISO 105 X12
Aim: To determine the colour fastness of the given sample to rubbing.
Material: Crock - o - meter, White sample, Dyed sample, Grey scale. .

Procedure:
Dry Rubbing
1) Take one test piece and fix it into rubbing device fix a piece of the dry undyed cloth in place over the end of the finger of the rubbing device and rub it to and from in straight line along the track which is 10cm long, on the dry test piece 10 times in 10sec, with downward frame of 900gms on the finger.
2) Treat the second test piece in a similar manner using a fresh piece of dyed sample and white sample. Evaluate the degree of staining on the white sample and the change in colour of the dyed sample with the help of grey scale and assign the rating.

Wet Rubbing
1) Take a fresh and dried piece of dyed fabric and fix it to the rubbing device. Soak a fresh piece of white fabric in the distilled water and squeeze the excess so that it contains its own weight of water.
2) Fix the wet piece of white sample over the end of the finger of the rubbing device and conduct the test in straight line along the track of 10cms rubbed 10 times in 10secs with downward force of 900gms on the finger.
3) Dry the piece at room temperature and evaluate the change in colour of the dyed fabric and degree of staining.

Figure 9.5: Crock - o - meter

Annexure 9.6
Colour Fastness to Perspiration:
Standard Test No. /Method: ISO 105 EO4
Aim: To determine the colour fastness of the given sample to acidic and alkaline perspiration.

Material: Perspir - o - meter, White sample, deyed sample, Oven, Acrylic plates.

Procedure:
1) The test specimen 5x10cm is sandwiched in a white cloth and the edges are stitched away.
2) The test specimen is then dipped in alkaline solution a liquor ratio of 50: 1 and allowed to remain in the solution at room temperature for 40minutes. The excess liquor is drained and the composite specimen is placed between the 2 acrylic separator plates.
3) Similarly the second composite specimen is made wet.
4) After loading the entire test specimen as above, acrylic separator plates are stacked one over the other and all these are placed in between the 2 loading stainless steel plates.
5) The loaded apparatus is placed inside a thermostatically controlled incubator maintained at 37ºC for 4 hours.
6) Once the time is over, the apparatus is removed from there and the acrylic plates are removed with the composite specimens from the apparatus.
7) The test specimen is separated from the adjacent fabric and evaluated for:
   - The colour change of the test specimen.
   - The degree of staining of the white the 2 pieces of the adjacent fabrics. They are evaluated using grey scales.

Figure 9.6: Perspir - o - meter

4.4.1 Colour fastness for washing
Standard Test No. / Method: ISO 105 C10
Equipment used: LAUNDER - O - METER

Rating Method: Gray Scale
5: Excellent No staining
4: Good Slight staining
3: Fair Noticeable staining
2: Poor Considerable staining
1: Very Poor severe staining

4.4.2 Light fastness
Standard Test No. / Method: AATCC – RR 92 2013
Equipment used: Light fastness tester

Rating Method: Gray Scale
8: Maximum fastness
7: Excellent fastness
6: Very good fastness
5: Good fastness
4: Fairly good fastness
3: Moderate fastness
2: Slight fastness
1: Very Poor fastness

4.4.3 Fastness to Dry and Wet Rubbing
Standard Test No. / Method: ISO 105 X12
Equipment used: CROCK - O - METER

Rating Method: Gray Scale
5: Excellent - No staining
4: Good - Slight staining
3: Fair - Noticeable staining
2: Poor - Considerable staining
1: Very Poor - Severe staining

4.4.4 Fastness to Acid and Alkaline Perspiration
Standard Test No. / Method: ISO 105 E04
Equipment used: PERSPIR - O - METER

Rating Method: Gray Scale
5: Excellent - No staining
4: Good - Slight staining
3: Fair - Noticeable staining
2: Poor - Considerable staining
1: Very Poor - Severe staining

5. Results and Discussions

5.1 Qualitative Analysis

5.1.1 Burning Test
The vertical yarns are the warp yarns and are represented as Set A.
The horizontal yarns are the weft yarns and are represented as Set B.

Table 5.1.1

Test	Set A (Vertical Yarns)	Set B (Horizontal Yarns)
Approaching flame	Scorches and ignites easily	Scorches and ignites easily
In flame	Burns quickly with yellow flame	Burns quickly with yellow flame
Away from flame	Continues to burn with an afterglow	Continues to burn with an afterglow
Odour	Burning paper	Burning paper
Residue	Light, Feathery, Grey ash	Light, Feathery, Grey ash

Results:
Set A: - Burn quickly with yellow flame, give burning paper odour with light feathery grey ash that it is a cellulosic fiber.
Set B: - Burn quickly with yellow flame, give burning paper odour with light feathery grey ash that it is a cellulosic fiber.

5.1.2 Microscopic Test
The vertical yarns are the warp yarns and are represented as Set A.
The horizontal yarns are the weft yarns and are represented as Set B.

Table 5.1.2

Set A (Vertical yarn)	Set B (Horizontal yarn)
Longitudinal view of the fiber is like a cylindrical swollen structure with less frequent convolutions. In the cross - section, the fibers appear to be round or oval with a central point indicating the lumen.	Longitudinal view of the fiber is like a cylindrical swollen structure with less frequent convolutions. In the cross - section, the fibers appear to be round or oval with a central point indicating the lumen.

Results:
From the Microscopic test it is found that
Set A: Cotton **Set B:** Cotton

5.1.3 Chemical Test
The vertical yarns are the warp yarns and are represented as Set A.
The horizontal yarns are the weft yarns and are represented as Set B.

Table 5.1.3

Reagent	Set A	Set B
Dil. H_2SO_4	No Reaction	No Reaction
Conc. H_2SO_4	Disintegrates and Dissolves	Disintegrates and Dissolves
10% NaOH	Swells Slightly	Swells Slightly
10% NaOH after heating	Swells Slightly	Swells Slightly
45% NaOH	Opens up and swells	Opens up and swells
45% NaOH after heating	Swells, Yellow mass formation	Swells, Yellow mass formation
Acetone	No Reaction	No Reaction

Results:
From the above test it is found that
Set A: Cotton
Set B: Cotton

5.2 Fastness to Washing

Fastness to washing of Marigold petals

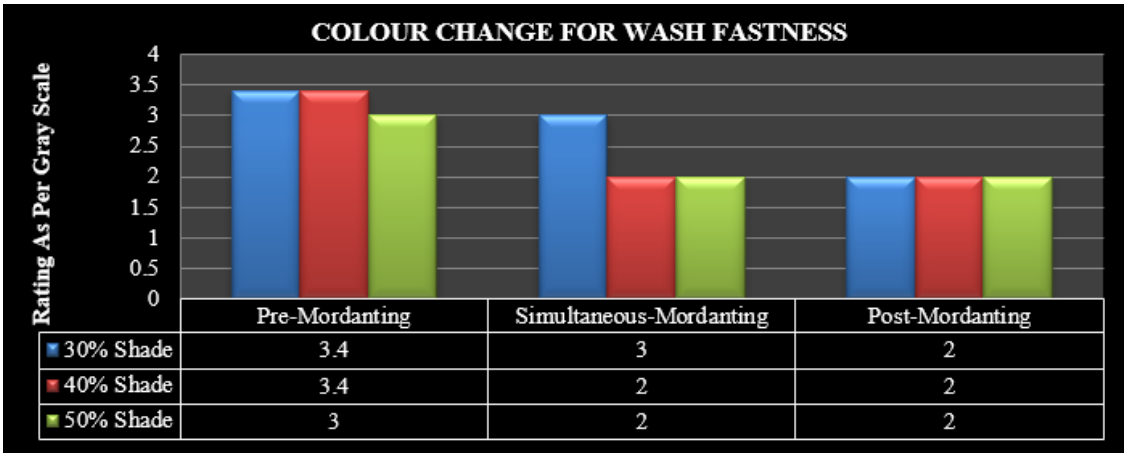

Figure 5.2.1: Colour changed for wash fastness of cotton fabric

Fastness to washing of Onion

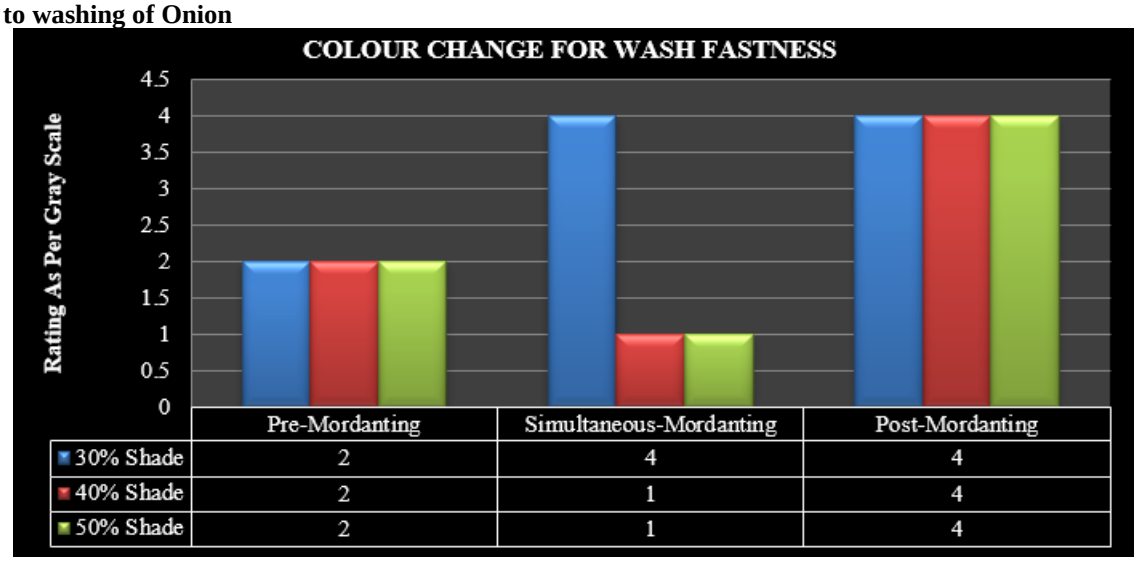

Figure 5.2.2: Colour changed for wash fastness of cotton fabric

Results: Wash fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour change rating it has being observed that Wash fastness rating of Post - Mordanting falls in the range of 4 for all the % shade.

It shows that cotton fabric dyed with post - mordanting have better wash fastness than pre and simultaneous - mordanting. It is observed that cotton fabric dyed with pre - mordanting and simultaneous - mordanting showed that lighter shade have better wash fastness as compared to the darker shade. Hence, according to the above figure it is observed that the wash fastness property of Marigold dyed fabric is Fair in proportion of the %shade and Onion dyed fabric is Poor in proportion of the %shade.

5.3 Fastness to light

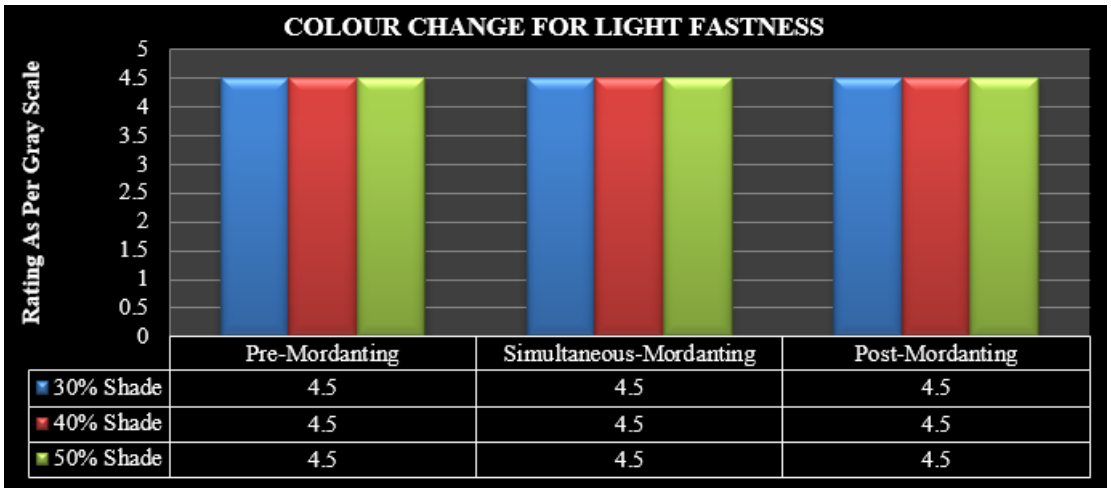

Figure 5.3.1: Colour changed for light fastness of cotton fabric

Fastness to Light of Onion

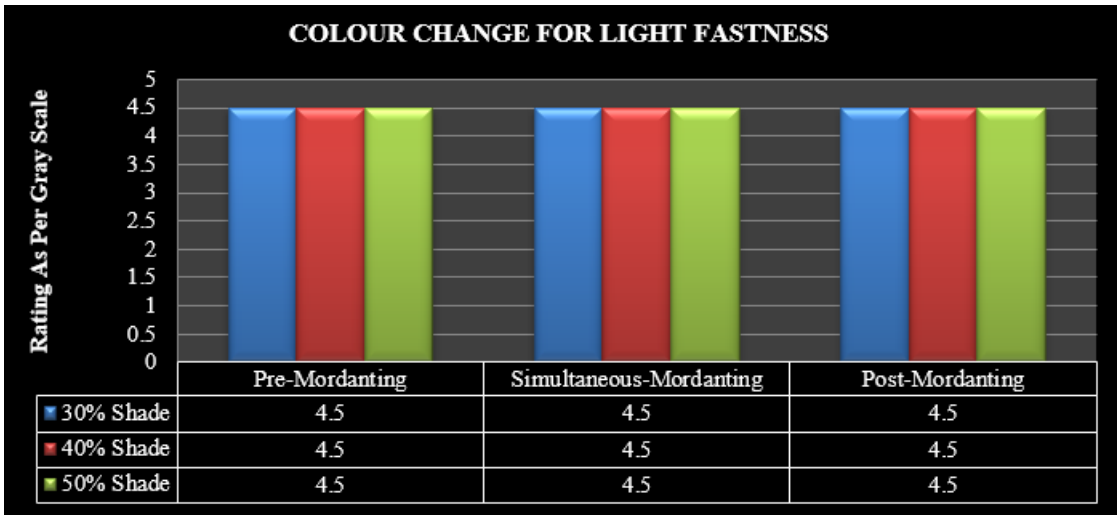

Figure 5.3.2: Colour changed for light fastness to cotton fabric

Results: Light fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour change rating it has being observed that Light fastness rating for overall dyeing falls in the range of 4.5 for all the % shade. Hence, according to the above figure it is observed that the light fastness property of Marigold dyed fabric is Excellent in proportion of the %shade and Onion dyed fabric is Excellent in proportion of the %shade.

5.4 Fastness to Dry Rubbing and Wet Rubbing

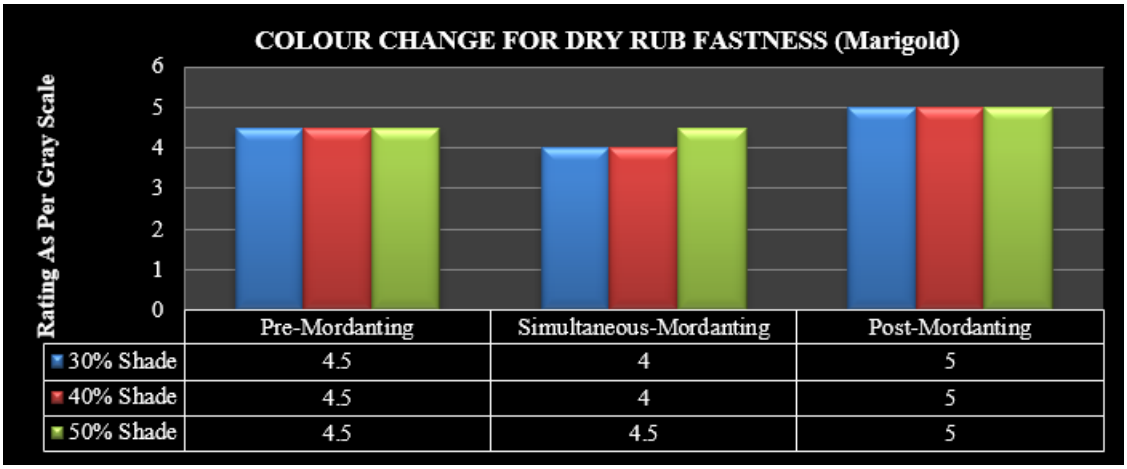

Figure 5.4.1: Colour changed for Rub fastness: Dry Test

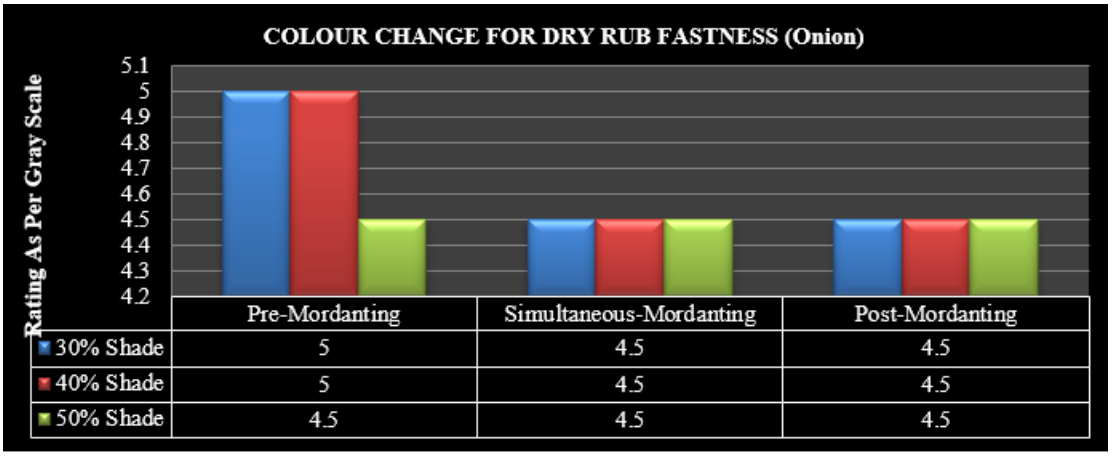

Figure 5.4.2: Colour changed for Rub fastness: Dry Test

Results: Dry rub fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour change rating

it has being observed that Dry rub fastness rating for overall dyeing falls in the range of 4.5 & 5 for all the % shade.
Hence, according to the above figure it is observed that the Dry rub fastness property of Marigold dyed fabric is Excellent in proportion of the %shade and Onion dyed fabric is Excellent in proportion of the %shade.

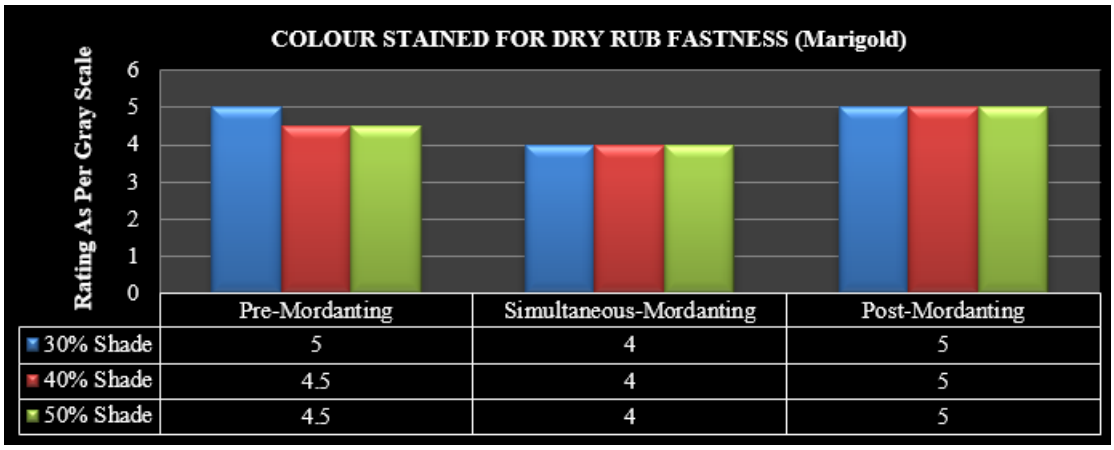

Figure 5.4.3: Colour stained for Rub fastness: Dry Test

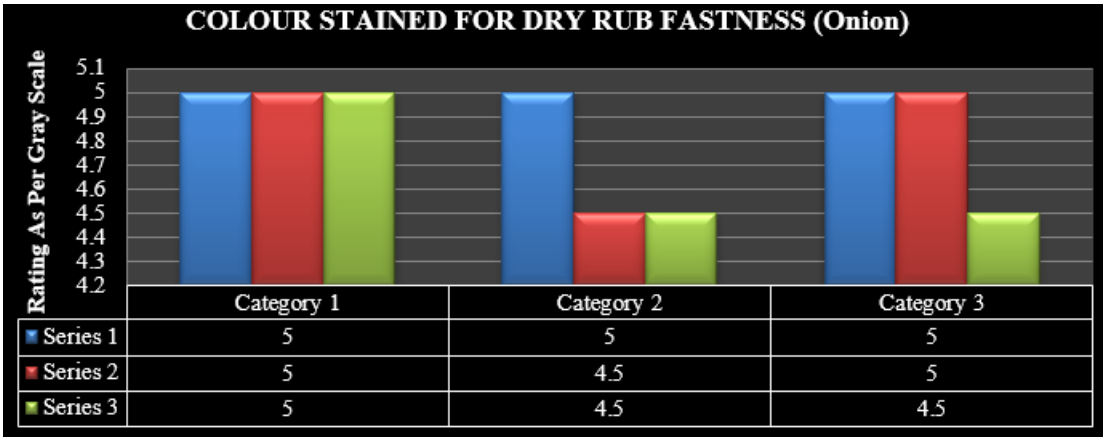

Figure 5.4.4: Colour stained for Rub fastness: Dry Test

Results: Dry rub fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour stained rating it has being observed that Dry rub fastness rating for overall dyeing falls in the range of 4.5 & 5 for all the % shade.
Hence, according to the above figure it is observed that the Dry rub fastness property of Marigold dyed fabric is Excellent in proportion of the %shade and Onion dyed fabric is Excellent in proportion of the %shade.

Fastness to Wet Rubbing of Marigold petals

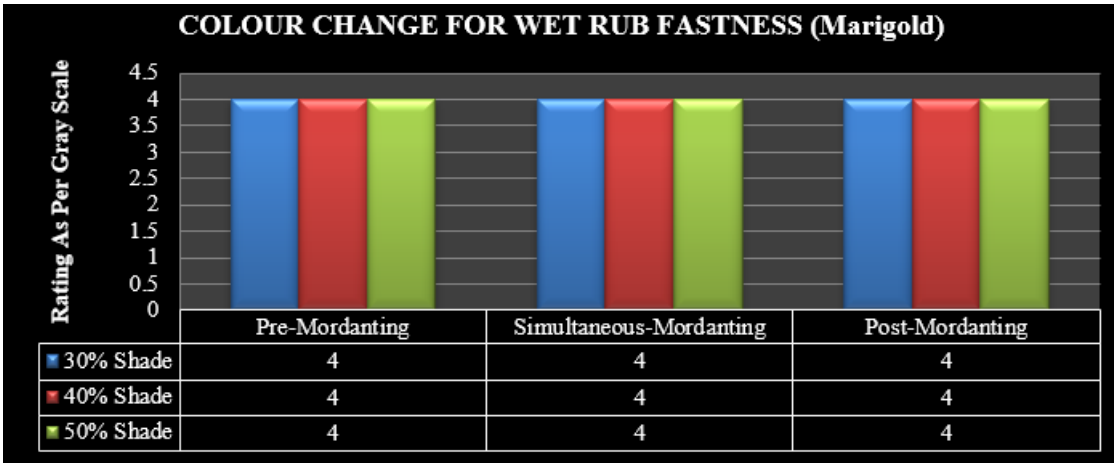

Figure 5.4.5: Colour changed for Rub fastness: Wet Test

Fastness to Wet Rubbing of Onion

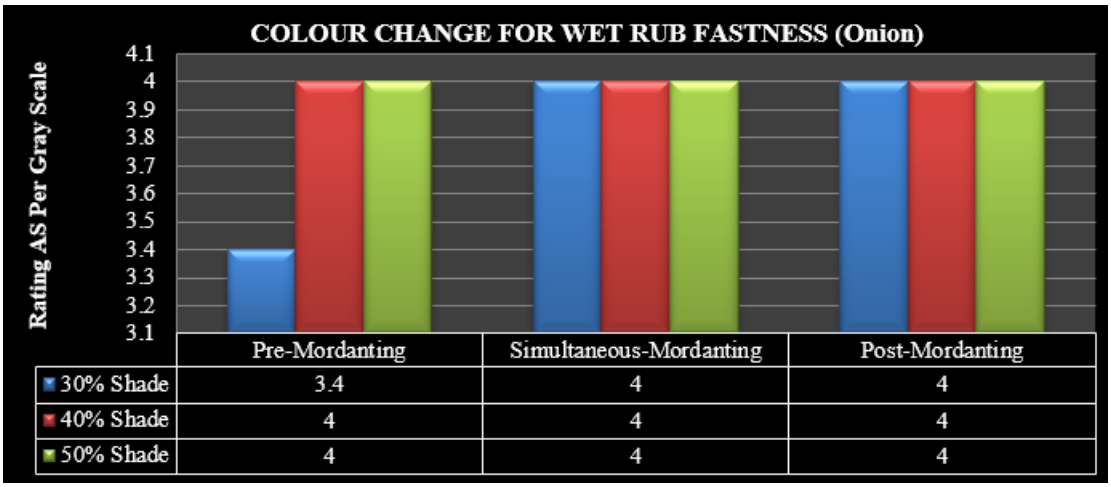

Figure 5.4.6: Colour changed for Rub fastness: Wet Test

Results: Wet rub fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour change rating it has being observed that Wet rub fastness rating for overall dyeing falls in the range of 4 for all the % shade. Hence, according to the above figure it is observed that the Dry rub fastness property of Marigold dyed fabric is Good in proportion of the %shade and Onion dyed fabric is Good in proportion of the %shade.

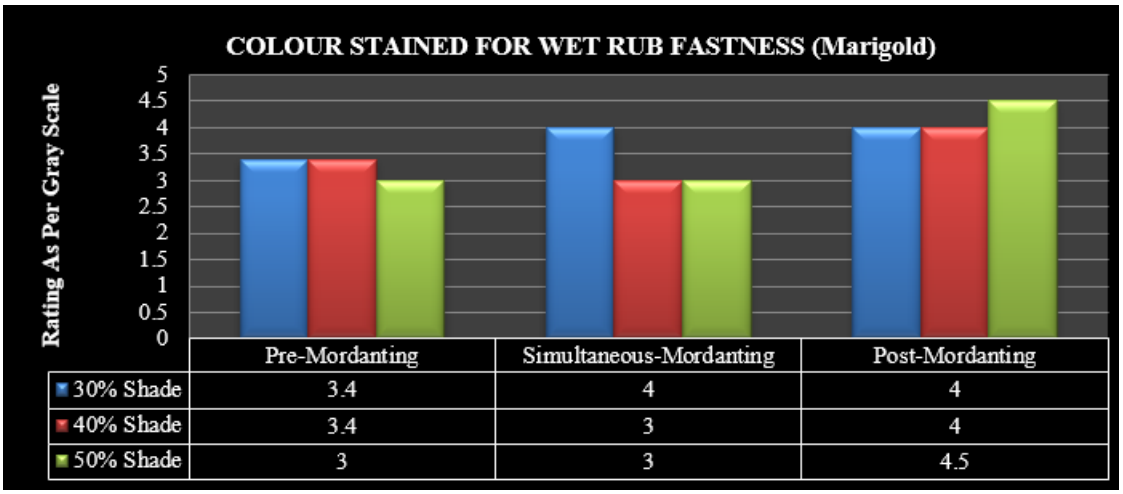

Figure 5.4.7: Colour stained for Rub fastness: Wet Test

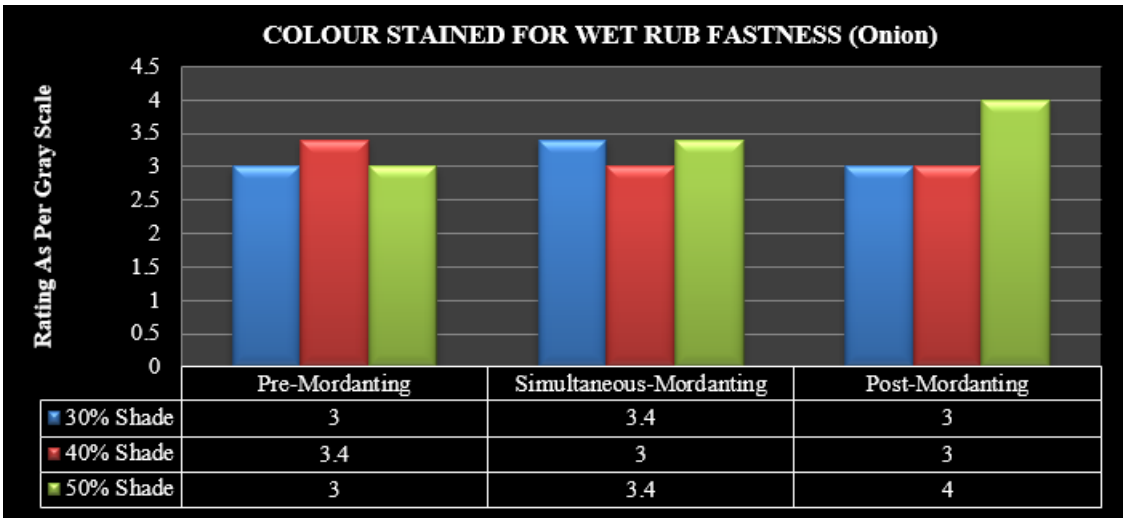

Figure 5.4.8: Colour stained for Rub fastness: Wet Test

Results: Wet rub fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour stained rating it has being observed that Wet rub fastness rating for Pre - Mordanting dyeing falls in the range of 3.4 for all the % shade.

It shows that cotton fabric dyed with less %shade have good wet rub fastness then the high %shade. So, Pre - mordanting dyed fabric showed good results for marigold dyed fabric and Simultaneous - mordanting dyed fabric showed good results for onion dyed fabric. Hence, according to the above figure it is observed that the Wet rub fastness property of Marigold dyed fabric is Good in proportion of the %shade and Onion dyed fabric is Good in proportion of the %shade.

5.5 Fastness to Alkaline Perspiration and Acid Perspiration

Fastness to Alkaline Perspiration of Marigold petals

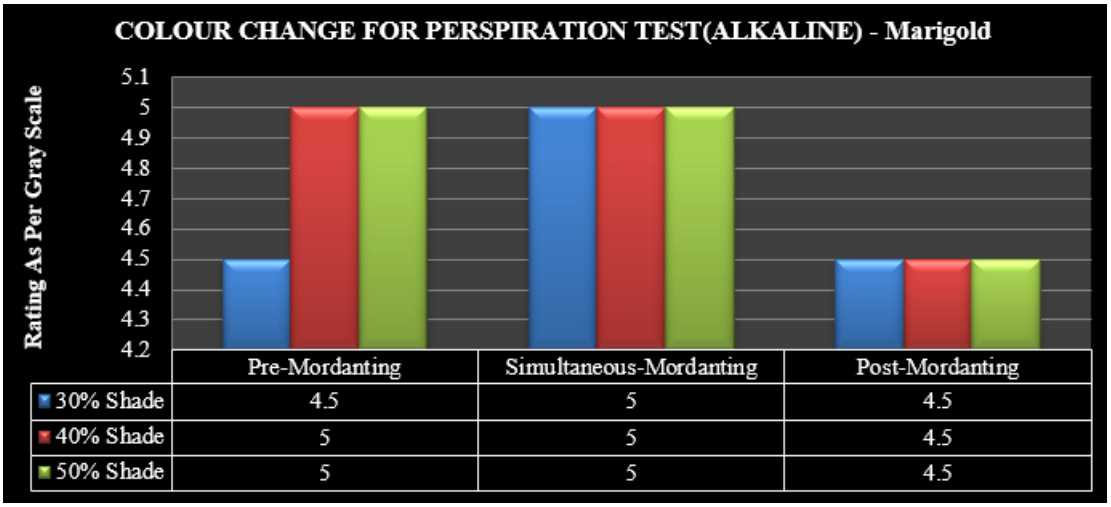

Figure 5.5.1: Colour changed for Perspiration of Cotton fabric: Alkaline Test

Fastness to Alkaline Perspiration of Onion

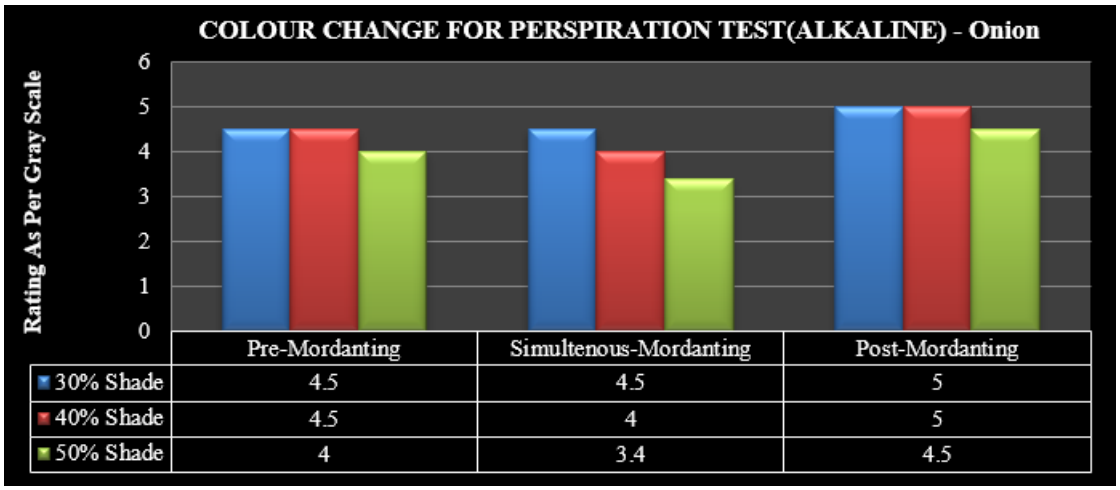

Figure 5.5.2: Colour changed for Perspiration of Cotton fabric: Alkaline Test

Results: Alkaline Perspiration fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour change rating it has being observed that Alkaline Perspiration fastness rating for overall dyeing falls in the range of 4.5 & 5 for all the % shade. Hence, according to the above figure it is observed that the Alkaline Perspiration fastness property of Marigold dyed fabric is Excellent in proportion of the %shade and Onion dyed fabric is Excellent in proportion of the %shade.

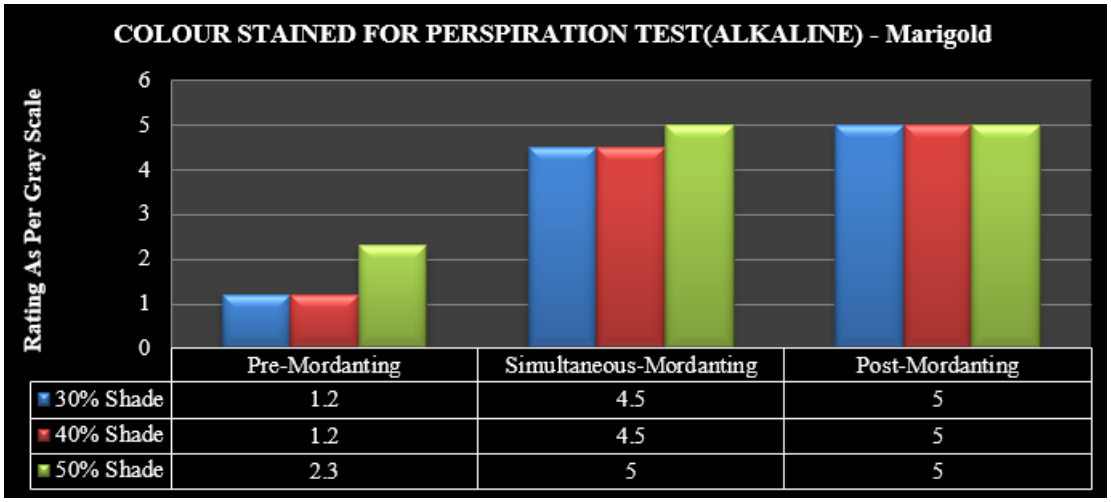

Figure 5.5.3: Colour stained for Perspiration of Cotton fabric: Alkaline Test

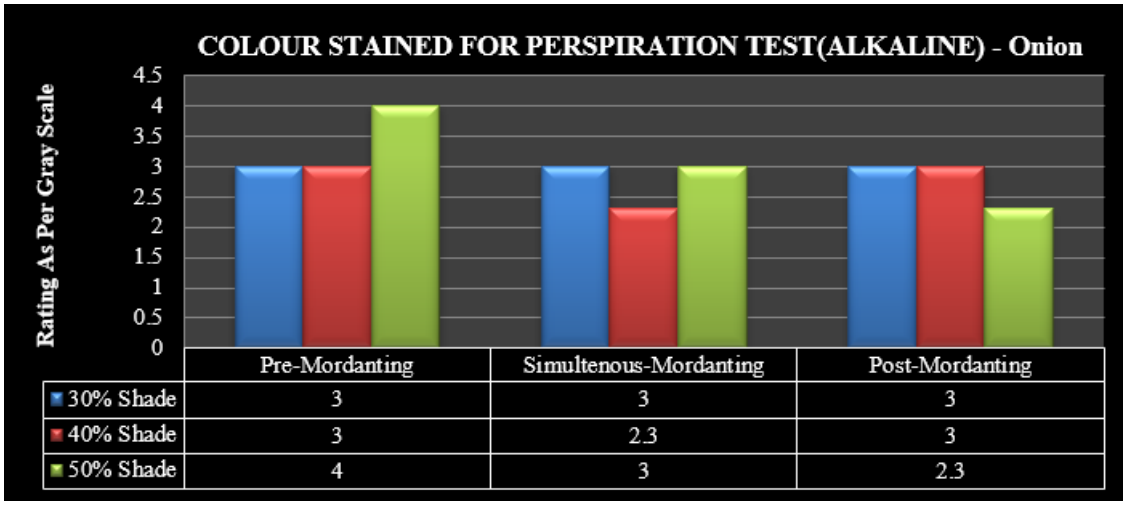

Figure 5.5.4: Colour stained for Perspiration of Cotton fabric: Alkaline Test

Results: Alkaline Perspiration fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour stained rating it has being observed that Alkaline Perspiration fastness rating for Simultaneous and Post Mordanting dyeing falls in the range of 4.5 & 5 for Marigold dyeing which in result to Good staining and Pre - mordanting dyeing falls in range of 1.2 which in result to very poor staining. It is observed that Alkaline Perspiration fastness rating for overall dyeing falls in the range of 2.3 & 3 for Onion dyeing fabric all the %shade which in result to Poor staining. Hence, according to the above figure it is observed that the Alkaline Perspiration fastness property of Marigold dyed fabric is Good Staining in proportion of the %shade and Onion dyed fabric is Poor Staining in proportion of the %shade.

Fastness to Acid Perspiration of Marigold petals

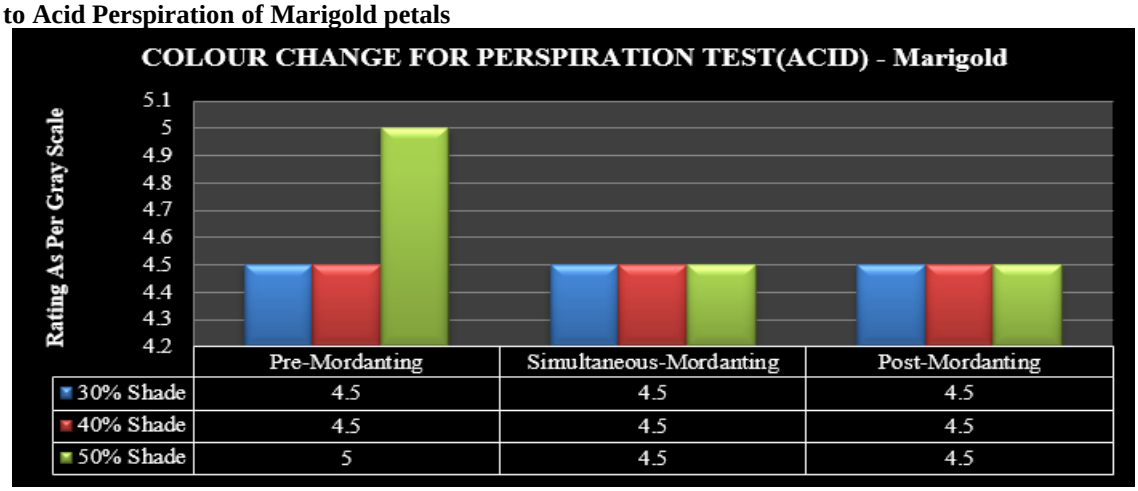

Figure 5.5.5: Colour change for Perspiration of Cotton fabric: Acid Test

Fastness to Acid Perspiration of Onion

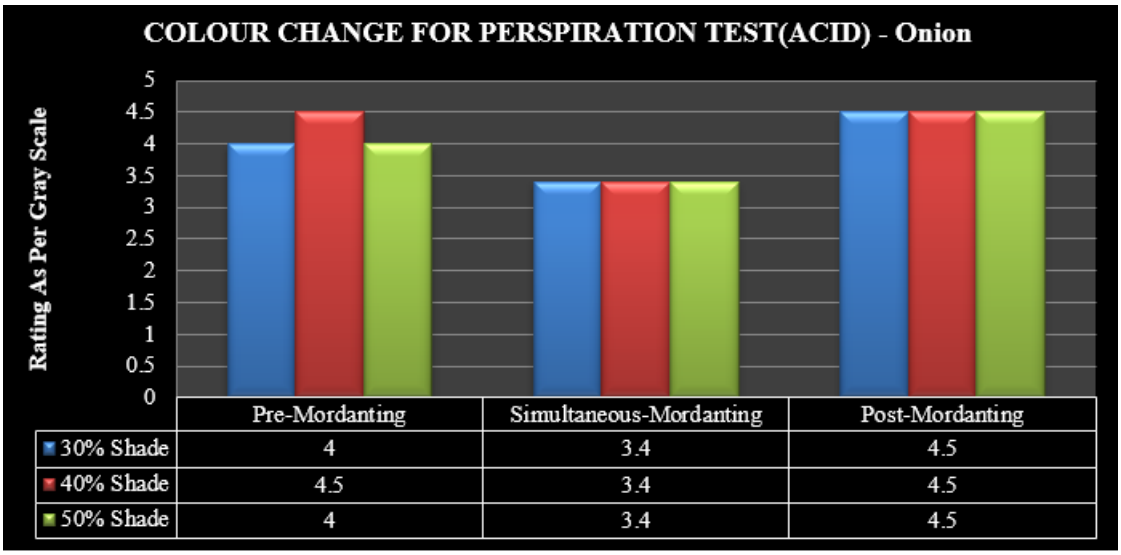

Figure 5.5.6: Colour changed for Perspiration of Cotton fabric: Acid Test

Results: Acid Perspiration fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour change rating it has being observed that Acid Perspiration fastness rating for overall dyeing falls in the range of 4.5 for all the % shade. But with the Simultaneous - mordanting dyed fabric falls in the range of 3.4 for Onion dyed fabric for all the %shade. Hence, according to the above figure it is observed that the Acid Perspiration fastness property of Marigold dyed fabric is Excellent in proportion of the %shade and Onion dyed fabric is Excellent in proportion of the %shade.

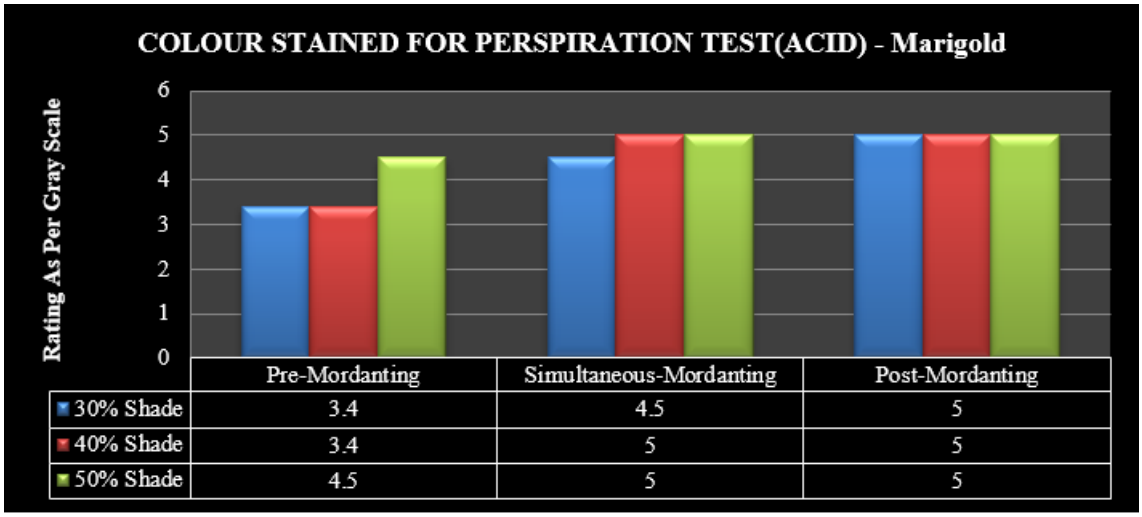

Figure 5.5.7: Colour stained for Perspiration of Cotton fabric: Acid Test

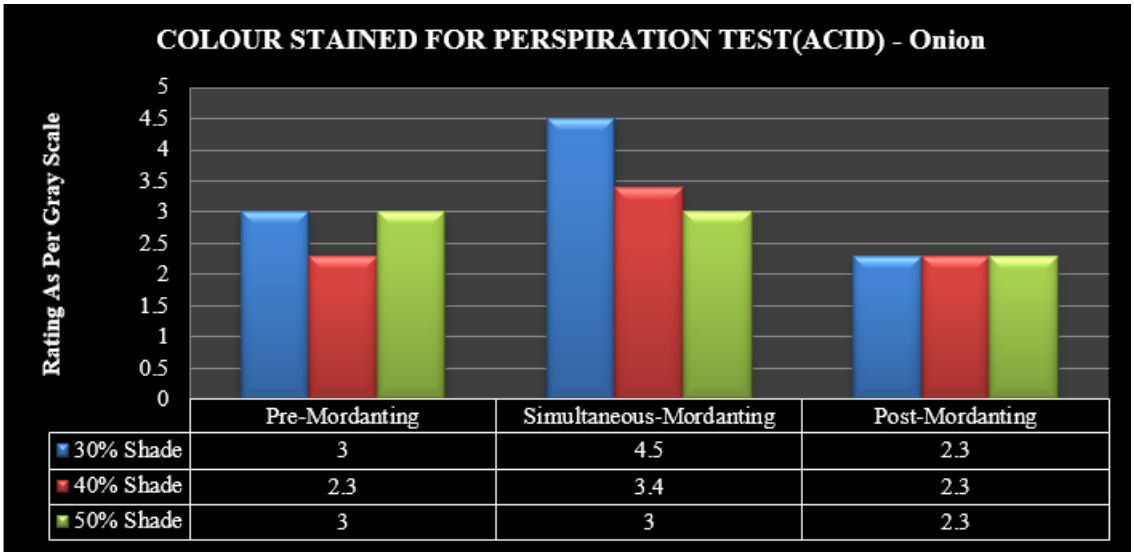

Figure 5.5.8: Colour stained for Perspiration of Cotton fabric: Acid Test

Results: Acid Perspiration fastness test was carried out on cotton fabric dyed with Marigold and Onion dyes in the presence of natural mordant cowdung using different shade % such as 30%, 40%, 50% and According to SDC Grey scale colour stained rating it has being observed that Acid Perspiration fastness rating for Simultaneous and Post Mordanting dyeing falls in the range of 4.5 & 5 for Marigold dyeing which in result to Excellent staining and Pre - mordanting dyeing falls in range of 3.4 which in result to Good staining. It is observed that Acid Perspiration fastness for Onion dyed fabric rating for overall dyeing falls in the range of 2.3 & 3 for all the %shade which in result to Poor staining.

Hence, according to the above figure it is observed that the Acid Perspiration fastness property of Marigold dyed fabric is Good Staining in proportion of the %shade and Onion dyed fabric is Poor Staining in proportion of the %shade.

6. Summary and Conclusion

Conclusion Natural dyeing:

- Firstly, the Marigold Petals were used for the trial with the help extraction method the dye was extracted in the Soxlet unit and the natural mordant cowdung was used to dye the fabric which gave colour to the fabric but the shades produced was very light and dull.
- By 10% and 20% shade the dyeing was done which gave a light colour on cotton fabric.
- So, to get better shade the method was changed from extraction to exhaust method which gave a better result than the previous.
- Pre - mordanting produced better colour shade than the post - mordanting and simultaneous - mordanting in the trial.
- In the pilot study, Marigold was used in various shades like 30%, 40%, 50% shade resulted in variations in shade development though more quantity was required to obtain the desire colour depth.
- It was found that a marigold affected the depth of shade developed and further this leads to the realization that a single natural source can produce different shades of colour.
- So along with the marigold dye the onion peels was also used to dye the fabric with same percent shades.
- The more the depth of the percent shade the darker the colour development on the fabric as compared to the lesser percent shade.
- The natural mordant (cowdung) was used as 5% shade.
- The shade developed was in range of beige, golden yellow, dark yellow, reddish brown.
- Pre - mordanting showed better shades than post - mordanting, simultaneous - mordanting.

Conclusion for Qualitative Analysis:

- In the Qualitative Analysis test, burning test the fibers produced the prominent burning paper smell and residue was in the form of light, feathery, grey ash.
- In the Microscopic test, some fibers show round or oval with a central point indicating the lumen.
- In the chemical solubilty test, some fibers open ups, swells up also disintegrates and dissolve when treated with conc. H_2SO_4 and NaOH result showed that fabric content is 100% cotton so that it was concluded that fabric was 100% cotton fabric.

Conclusion for Colour fastness property:

- Marigold dyed fabric showed good result then the onion dyed fabric in comparison to wash fastness property.
- The light fastness properties of both the sample ranged from Excellent to Good results on the cotton fabric.
- With regards to the dry rub fastness it showed an excellent result as compared to the wet rub fastness. In the wet rub fastness it showed good to fair results on the cotton fabric.
- In the Perspiration testing the acid test showed excellent result then the alkaline test on the cotton fabric.

7. Limitations and Recommendations

Limitations:

- Study was limited to 1 type of Natural Mordant and 2 types of Natural dyes.
- In this study only one type of fabric was used.

Recommendations:

- Other dyes (herbs) and mordants can be used
- Other fabrics such as silk, wool, etc. can be used for research
- Different concentration can be used
- Other dyeing method can be used
- Finishes can be applied to enhance fabric property and to improve its property

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