NATURAL DYE'S SAFE AND ECO-FRIENDLY

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1. ABSTRACT

Natural dyes present in plants pigments like betalaines, xanthophylls, anthocyanins, chlorophylls, tannins, flavonoids, etc can be used as natural colours for various industries like food, beverages, cosmetics, textiles etc. As manufacturing and disposal of the enormous effluents formed during synthetic dye are affecting environment. Natural dyes can be rescue to us if used in smart manner. Waste vegetables and others plant product damaged during transportation used as a source of natural dye. The results are incredible and are also safe for skin and do not cause any allergies. Natural dyes are also eco-friendly, thus helping us to save our nature.

KEYWORDS: *Beta vulgaris, Cucurbita maxima, Eugenia jumbolana, Lilium longiflorum,* natural dye, *Spinach oleracea, Solanum melongena* and textile.

2. INTRODUCTION

The word 'natural dye' covers all the dyes derived from the natural sources like plants, animal and minerals. Natural dyes are mostly non-substantive and must be applied on textiles by the help of mordants, usually a metallic salt, having an affinity for both the colouring matter and the fibre. Transition metal ions usually have strong co-coordinating power and/or capable of forming week to medium attraction/interaction forces and thus can act as bridging material to create substantively of natural dyes/colorants' when a textile material being impregnated with such metallic salt (i.e. mordant) is subjected to dyeing with different natural dyes, usually having some mordant able groups facilitating fixation of such dye/colorant.

Natural dyes can be classified in a number of ways. The earliest classification was according to alphabetical order or according to the botanical names. Later, it was classified in various ways, e.g. on the basis of hue, chemical constitution, application class etc. Gulrajani & Gupta, 1992 classified natural dye on the basis of its application majorly describing according to plant pigments and their occurrence, some are listed in below table:-

Table 21. Plant pigments and their occurrence

Pigment	Common types	Place of presence	Colours found
Chlorophylls	Chlorophyll	Green plants	Green
Carotenoids	Carotenes and xanthophylls (e.g. astaxanthin)	Bacteria. Green plants (masked by chlorophyll), vegetables like carrots, mangoes and so on.	Oranges, reds, yellows, pinks
Flavonoids	Anthocyanines,	Produce many colors in flowers.	Yellow, red, blue,

	aurones, chalcones, flavonols and proanthocyanidins	Common in plants such as berries, eggplant, and citrus fruits. Present in certain teas, wine, and chocolate	purple
Betalaine	Betacyanins and Betaxanthin	Flowers and fungi	Red to violet, also yellow to orange.

Global consumption of textiles is estimated at around 30 million tonnes per annum and this is expected to grow further at the rate of 3% per annum. To colour textiles of this quantum 70,000 tonnes of dyes would be required. Thus, the manufacturing and disposal of the enormous effluents would certainly add to environment pollution. Thus synthetic colours have come under scrutiny by regulatory agents. In wake of this, focus has once again shifted to usage of natural colours for various industries like food, beverages, cosmetics, textiles etc. (Gulrajani & Gupta, 1992).

The present investigation mainly deals with natural dyes to be used by the textiles industry. It was on the priority basis that the source should be of less important. Hence, waste vegetables and others plant product was targeted as many amount are damaged during transportation.

3. METHOD AND MATERIALS

For the present study, plants *Beta vulgaris, Spinach oleracea, Cucurbita maxima, Eugenia jumbolana, Solanum melongena* and *Lilium longiflorum* were selected which was collected from wholesale market. Natural cotton fabric 100% was selected as a fabric for dying. The fabric was purchased from Dadar textiles market, Mumbai. Potash alum was used as mordant. Effects of some processes were also studied on dyed cotton fabric.

Equipment used: old stainless steel vessel (5 litres), wooden stirrer, 180 micron stainless sieve, heating gas, plastic‘s tray, motor and pestle, rubber gloves and 1 litre plastic beaker.

Chemical’s requirement: Potash Alum and distilled water.

Plant parts used: Tuber of beet *Beta vulgaris*, leaf of *Spinach oleracea*, fruit pulp of *Cucurbita maxima, Eugenia jumbolana* and *Solanum* melongena and anther of *Lilium longiflorum*. All plant material used was waste remains after transportation to wholesale market.

Preparation of cotton fabric for dyeing

Cotton fabric was cut into 10x10 sq.cm pieces. In a stainless vessel with 1litre of water 5 grams of common salt was boiled and cotton fabric square was soaked in it. This process clear the fabric of any reagents or enzymes used during processing. Later on it was washed with the cold water till all the stickiness is gone from the fabric. Fabric was shed dried and later on was used for dyeing.

Procedure of dyeing

Plant material selected was shed dried powdered. Sieve mesh of 180 micron was used to separate bigger particle. In old stainless steel vessel filled with the mixture of distilled water and plant material in ratio of 1:3 was boiled for 30 minutes on high flame (until the required colour you seen). The pre-treated cotton fabric squares was soaked in the boiling dye and stirring gently with a wooden stirrer to make sure the dye covers evenly the fabric. The fabric was removed from the water with tongs in a tray. The boiled decoction was filtered. The filtrate dye is reused by leaving the fabric in the filtrate dye for overnight. This is to make sure all possible dyeing compounds are used from plant material. Next, day again the fabric was boiled in filtrate dye with powered alum which acts as a mordant so that the dye can last longer. Rinsed in cold water and shed dried for result.

4. DISCUSSION

The cotton fabric dyed with tuber of beet *Beta vulgaris*, leaf of *Spinach oleracea*, fruit pulp of *Cucurbita maxima*, *Eugenia jumbolana* and *Solanum* melongena and anther of *Lilium longiflorum* showed a variety of colours. The colour development by beet is pinkish red colour due to betalaine. The pumpkin's yellow colour is due to carotene and xanthophylls. The Jamun gives grayish blue colour due to flavonoids and anthocyanins. Eggplant gives brownish colour of tannin's and anthocyanins. Spinach gives greenish dye due to amalgam of carotenes yellow-orange, pheophytin a gray, which is nearly as intense as chlorophyll b, chlorophyll a blue-green, more intense than chlorophyll b. Lily anther gives orangish yellow due to betalaine's, carotenes and xanthophyll .

Most of the natural dyes have poor light stability (as compared to that of the best synthetic dyes), and for example the colours in museum textile are often different from their original colours. The relative light stability of a range of dyes has been reviewed by Padfield & Landi, 1966 along with studies involving change in qualitative fashion.

Some dyes undergo marked changes in hue on washing, shown to be attributed to even small amounts of alkali in washing mixtures, high-lighting the necessity of knowing the pH of alkaline solutions used for cleaning of textiles dyed with natural dyes. Hence, the dyed fabric was tested for wash fastness. The result was good but it can be better if there is small increase in cleaning efficiency attributable to the alkali. They must be balanced against possible colour change in the natural dyes, apart from possible damage under alkaline conditions which was discussed by Hofenk 1983 and Duff et al, 1977.

5. LIMITATION OF NATURAL DYES/ COLORANTS

It is difficult to reproduce shades by using natural dyes/colorants', as these agro products vary from one crop season to another crop season, place to place and species to species, maturity period etc. It is also difficult to standardize a recipe for the use of natural dyes, as the natural dyeing process and its colour development depends not only on colour component but also on materials. Natural dyeing requires skilled workmanship and is therefore expensive. Low colour yield of source natural dyes thus necessitates the use of more dyestuffs, larger dyeing time and excess cost for mordants and mordanting. Scientific backup of a large part of the science involved in natural dyeing is still need to be explored. Lack of availability of precise technical knowledge on extraction and dyeing techniques is still seen. The dyed textile may change colour when exposed to the sun, sweat and air.

6. CONCLUSION

Natural dyes present in plants due to pigments like betalaines, xanthophylls, anthocyanins, chlorophylls, tannins, flavonoids, etc are sensitive to light and water in the external environment. The mean value of wash and light fastness shows the effect of treatment on the dyed samples respectively.

Natural dyes fade after 20-25 times of treatment. These dyes are normally used to dye natural fabric like cotton and silk. Natural fabric has a comparatively shorter life span than synthetic fabrics. Hence , even though natural dyes fade after 20-25 washes , they almost match the life of the fabric .If precautions like drying in shade and using less harsh detergents are followed , vegetable dyes can be made to last longer .

Commercial use of cotton cloth dyed with natural dyes can be helpful to mankind as naturally occurring dyes are safe for skin and do not cause any allergies. Natural dyes are also eco-friendly, thus helping us to save our nature.

7. ACHNOWLEGEMENT

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9. RESULT AND OBSERVATION

Cotton fabric with respective colour after dyeing (1-*Beta vulgaris*, 2-*Solanum melongena*, 3-*Spinach oleracea*, 4-*Lilium longiflorum*, 5-*Eugenia jumbolana* and 6-*Cucurbita maxima)*

Observation of visual reading

The dyed cotton squares wore analysed for their wash fastness and light fastness on the basis of visual reading with the control parent sample respectively. The readings have been taken on instrument of visual reading with gray scale standard (Textiles committee, Prabhadevi,

Dadar west) .The gray scale standard is visualized in midnoon light intensity provided by the instrument . The instrument has its own scale based on the difference caused due to any effect on the sample with respect to the control one. The gray scale ranges from 5, 5-4, 4, 4-3…1.

The control sample in this visualization readings are termed as the best readings, therefore every control sample is given the value of 5 in the visual reading which is the highest score.

Table 9.1. Visual readings of control sample

Sample number	Sample cloth dyed with	Visual reading
1	Beets - *Beta vulgaris*	5
2	Eggplant - *Solanum melongena*	5
3	Spinach - *Spinach oleracea*	5
4	Lily anther - *Lilium longiflorum*	5
5	Jamun - *Eugenia jumbolana*	5
6	Pumpkin - *Cucurbita maxima*	5

Observation of visual reading of wash fastness:-

The dyed cloth of each dye was treated with soaking in washing powder solution for 1 hour then water was drained. This was done for 20 times with each of the natural dyed cloth respectively.

The treated samples of this treatment were taken at the interval of 5 times multiple so that the result of wash fastness of visual reading could be analysed. The visual readings are as follows in the tabulated form of each natural dye.

Table 9.2. Wash fastness value

Washing Treated Sample	Visual Reading With Control					
	Eggplant	Lily Anther	Spinach	Jamun	Beet	Pumpkin
5 Times	4	4	4	4 - 3 or 3.5	4	4
10 Times	4 - 3 or 3.5	4 - 3 or 3.5	4 - 3 or 3.5	3 - 2 or 2.5	3	4 - 3 or 3.5
15 Times	4 - 3 or 3.5	3	3	3 - 2 or 2.5	3 - 2 or 2.5	4 - 3 or 3.5
20 Times	3	2	3 - 2 or 2.5	2	2	4 - 3 or 3.5

Observation of visual reading of light fastness:-

The dyed cloth of each dye wash treated for light fastness in sunlight. The samples were kept in sunlight for 3 hours between 12pm to 3pm so that they could be exposed to maximum intensity of sunlight.

The treatment was done with every natural dyed cloth for 20 consecutive days. The visual reading of light fastness of the samples was selected with 5 day intervals .The visual reading of treated sunlight samples are as follows:

Table 9.3. Light fastness value

Sunlight treated sample	Visual Reading With Control					
	Eggplant	Lily Anther	Spinach	Jamun	Beet	Pumpkin
5 days	4	4	4	5-4 or 4.5	4	4
10days	4	4	4—3 or 3.5	5-4 or 4.5	4—3 or 3.5	3
15 days	4—3 or 3.5	4—3 or 3.5	3	4	3	3—2 or 2.5
20 days	3	4---3 or 3.5	2	4	3—2 or 2.5	2

10. GRAPHS OF MEAN RESULT