

Natural Dye Extraction from Dioscorea Alata (Purple Yam)

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Abstract— Dyeing is a process of applying colouring matter directly on fibre, yarn or fabric without any additives. Natural dyes produce an extraordinary variety of products and complex colours that complements each other. Straight off a day synthetic leads to high environmental pollution. Natural dye sources are eco-friendly and permanent in fabrics. The present study focused on the extraction of dye from Dioscorea Alata (purple yam). The obtained dye yield a variety of colours and are processed with different types of mordants such as copper sulphate and ferrous sulphate. The cotton treated with copper sulphate and ferrous sulphate in acidic method provided best result and showed less wash fastness.

Key words: Natural Dye, Dioscorea Alata, Mordants, Cotton Cloth

purple, or reddish flesh. Yam tubers vary in size from that of a small potato to over 60 kg (130 lb.). Yam tubers can grow up to 15 m (49 ft.) in length and 7.6 to 15.2 cm (3.0 to 6.0 in) high.



Fig. 1: Purple Yam

Fig. 2: Yam paste

I. INTRODUCTION

A. General

The art of dyeing is as old as our civilization. Dyed textile remnants found during archaeological excavations at different places all over the world provide evidence to the practice of dyeing in ancient civilizations. Natural dyes were used only for the colouring of textiles from ancient times till the nineteenth century. As the name suggests, natural dyes are derived from natural resources. Primitive dyeing techniques included sticking plants to fabric, rubbing crushed pigments into cloth.

B. Different Natural Dyes in India

- Blue Dye obtained from Indigo Plant
- Red Dye obtained from Madder Plant
- Yellow Dye obtained from Turmeric
- Black and Brown Dyes obtained from Acacia Plant
- Saffron Dye obtained from Crocus Sativus Plant
- Morinda Dye obtained from Morinda Citrifolia tree
- Kamala Dye obtained from Kamala tree
- Orange Dye obtained from Himalayan Rhubarb shrub
- Cream and Grey Dyes obtained from Manju Phal tree

C. Advantages of natural dye

- 1) As synthetic dyes are toxic to environment, natural dyes gain importance due to its eco- friendly nature.
- 2) Cause no harm to the human skin.
- 3) Possess a wide range of antimicrobial and medicinal properties.
- 4) Sustainable as they are renewable and biodegradable.
- 5) Raw material is available in plenty.

II. CHARACTERISTICS OF PURPLE YAM

Dioscorea alata, known as purple yam, ube, or greater yam, among many other names, is a species of yam, a tuberous root vegetable. The tubers are usually vivid violet to bright lavender in color. They have a cylindrical shape starchy tubers with blackish or brown, bark-like skin and white,

III. MATERIALS & METHOD

A. Mordants

A mordant or dye fixative is a substance used to bind dyes on fabrics by forming a coordination complex with the dye, which then attaches to the fabric.

The following mordants were used:-

- 1) Ferrous Sulphate (FeSO_4)
- 2) Copper Sulphate (CuSO_4)

B. Chemicals

The following chemicals were used:-

- 1) Concentrated Sulphuric acid (H_2SO_4)
- 2) hydroxide (NaOH)

C. Scouring and Mordating

Scouring of cotton cloth: Cotton clothes used for dyeing were boiled in 10 % NaOH solution for 10 minutes to remove starch and other impurities from the cloth. The NaOH treated clothes were then thoroughly washed with cold distilled water.

1) Mordanting:

The clean scouring clothes were treated with different mordents such as Ferrous Sulphate (FeSO_4) and Copper Sulphate (CuSO_4).

D. Proposed Methodology

Extraction of colour dye is carried out by three different methods as follows:-

E. Acidic extraction method

Step 1: 50 gm of yam paste was treated with 1% H_2SO_4 solution of total volume 500 ml and was stirred in a flocculator for about 15 minutes so that a uniform mixture is formed.



Fig. 3: Mixture kept in a flocculator

Step 2: The mixture formed was boiled at 100 °C for 30 minutes in a water bath.

Step 3: After 30 minutes the decolorized yam was removed from the extraction solvent.

Step 4: Cotton sample was dipped in filtered solution containing different mordants and kept in hot air oven 24 hours.



Fig. 4: Cotton cloth dipped in the mixture containing mordants

Step 5: After 24 hours the amount of dye extracted from cotton sample was observed and then tested in a colorimeter.

Step 6: The cotton cloth was washed with the tap water and was allowed to dry under normal temperature.

Step 7: The difference between the cotton cloth before and after washing was observed.

F. Alkaline extraction method

Step 1: 50 gm of yam paste was boiled in 1% NaOH solution having volume of 500 ml and was stirred in a flocculator for about 15 minutes so that a uniform mixture is formed.

Step 2: The mixture formed was boiled in a water bath at 100°C for 30 minutes.

Step 3: After 30 minutes the decolorized yam was removed from the extraction solvent.

Step 4: Cotton sample was dipped in filtered solution and kept in hot air oven 24 hours.



Fig. 5: Cotton cloth dipped in the mixture containing mordants

Step 5: After 24 hours the amount of dye extracted from cotton sample was observed and then tested in colorimeter.

Step 6: The cotton cloth was washed with the tap water and was allowed to dry under normal temperature.

Step 7: The difference between the cotton cloth before and after washing was observed.

G. Aqueous Extraction Method

Step 1: 50 gm of yam paste was taken in a beaker containing 500ml of distilled water and was stirred in a flocculator for about 15 minutes so that a uniform mixture is formed.

Step 2: The mixture formed was boiled in a water bath at 100°C for 30 minutes.

Step 3: After 30 minutes, decolorized yam was removed from the extraction solvent.

Step 4: The cotton sample was dipped in the filtered extract solvent and kept in the hot air oven for 24 hours.



Fig. 6: Cotton cloth dipped in the mixture containing mordants

Step 5: After 24 hours the cotton sample was removed, the amount of dye extracted was observed and then tested in a colorimeter.

Step 6: The cotton cloth was washed with the tap water and was allowed to dry under normal temperature.

Step 7: The difference between the cotton cloth before and after washing was observed.

IV. RESULT & DISCUSSION

A. Dye Extraction Results

Shades of purple and green were obtained from solvent extraction with combination of different mordants.

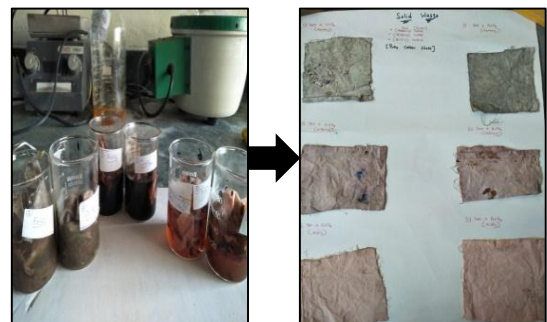


Fig.7 Dyes obtained from the material source

The acidic extract with FeSO_4 and CuSO_4 mordant gives Light Purple and Dark Purple coloured shades respectively. The Pale Green and Tea Green colour shades were obtained in alkaline extract with FeSO_4 and CuSO_4 mordant respectively. The aqueous extract gives Russian Green colour with FeSO_4 and Pale Green colour with CuSO_4 .

B. Water Fastness Test Results

The Rating of fastness properties of dye and Mordant are given in the Table-1.

Sr .No	Solvents	Cotton fabrics
1	Aqueous	Good
2	Alkaline	Good
3	Acidic	Poor

Table 1: Rating of fastness properties of dye and Mordant Before Wash: After Wash:



Fig. 8: Effect on Dyed Cotton Cloth before & after wash

C. Colorimeter Test Results

Colorimeter is an instrument that compares the amount of light getting through a solution with the amount that can get through a sample of pure solvent.

Sr .No.	Filters	Hazen (unit)
1	A	29
2	B	29
3	C	76
4	D	84
5	E	33
6	F	39
7	G	30
8	H	42

Table 2: Colorimeter Reading of Aqueous Extract

Sr .No.	Filters	Hazen (unit)
1	A	28
2	B	25
3	C	50
4	D	50
5	E	26
6	F	34
7	G	33
8	H	38

Table 3: Colorimeter Reading of Alkaline Extract

Sr .No.	Filters	Hazen (unit)
1	A	28
2	B	28
3	C	77
4	D	75
5	E	31
6	F	40
7	G	36
8	H	42

Table 4: Colorimeter Reading of Acidic Extract

V. CONCLUSION

By using the process discussed above, different shades of purple and green can be prepared using different mordants with natural dye. Thus, results obtained from present investigation revealed that, the purple yam has the dyeing potential as a source for cotton dyeing. Dyes obtained from purple yam waste can be used as cost effective and economically commercial for various industries such as textile, cosmetics, leather, food and pharmaceuticals.

As the dyes are made from kitchen waste it solves the problem of waste disposal as well as becomes a more sustainable option. Natural dyes were used in ancient times and can be used again in future if proper research and resources are used to convert them in a more economical and easily available option.

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REFERENCES

- [1] Jothi, D., Autex Research Journal, 2008. 8(2): p. 49-53
- [2] Mathur, N., Bhatnagar, P. and Bakre, P., Applied Ecol. Environ. Res. 2005. 4: p. 111-118
- [3] Mehra R.H. and Mehra A.R., 'Colourage', 40(9), 58, 1993.
- [4] Gulrajani M.L., "Indian Journal of Fibre and Textile Research", 26(1-2), 191-201, 2001.
- [5] Gulrajani M.L., Gupta, D., "Natural Dyes and Their Application to Textiles", Department of Textile Technology, IIT, New Delhi, 1992.
- [6] <http://www.ecoideaz.com/expert-corner/growing-popularity-natural-dyes-india>
- [7] Applications of Natural Dye Chart. From Shahid, M., Islam, S., Mohammad, F., 2013. Recent advancements in natural dye applications: a review. J. Clean. Prod. 53, 310-331.
- [8] <https://npgsweb.arsgrin.gov/gringlobal/taxonomydetail.aspx?id=14175>
- [9] https://en.m.wikipedia.org/wiki/International_Union_of_Pure_and_Applied_Chemistry
- [10] Neha Grover and Vidya Patni. Extraction of application of natural dye preparation from the floral parts of *Woodfordia fruticosa* (Linn.) Kurz., Indian Journal of Natural Products and Resources, 2(4), 2011- 403-408.
- [11] Kamel, M. M., Helmy H. M. and Hawary N. S. Some studies on dyeing properties of cotton fabrics with *Crocus sativum* (Saffron) flower using an ultrasonication method, Autex Research Journal 9 (1), 2009.
- [12] Jothi, D. Extraction of Natural dye from African marigold flower (*Tagetes erecta*) for textile colouration, Autex Res. J., 8(2), 2008- 49-53.

[13]“Fastness properties Assessment on Dyed fabrics”
<http://nptel.ac.in/courses/116104046/20.pdf>

