

Optimization of Natural Dye from Citrus Sinensis

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Abstract - The wastewater from textile plants is classified as the most polluting of all the industrial sectors, considering the volume generated as well as the effluent composition. To combat the problem, this paper focuses on alternative dyeing options using the organic waste present in households like orange peels. The dye was extracted by aqueous extraction and alkaline method and dye was analysed by applying on cotton fabric. Different shades were produced using mordants like ferrous sulphate and copper sulphate. Since orange peels are readily available and are cheap, they can be used to create natural and biodegradable dye.

Key Words: (Cotton fabric, Natural dye, Orange peels, Mordents, organic waste)

1. INTRODUCTION

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 or rubbing crushed pigments into cloth [1].

Colouring materials obtained from natural resources of plant, animal, mineral and microbial origins were used for coloration of various textile materials. The textile industry plays a major role in the economy of Asian and other countries. In India, it accounts for the largest consumption of dyestuff at 80% [2].

Taking in every type of dye and pigment produced, this amounts to close to 80,000 t. India is the second largest exporter of dyestuff, after China. Different regions of the world had their own natural dyeing traditions utilizing the natural resources available in that region. In the early 21st century, the market for natural dyes in the fashion industry is experiencing the resurgence. Western consumers have become more concerned about the health and environmental impact of synthetic dyes in manufacturing and there is a growing demand for products that use natural dyes. Nature has gifted us more than 500 dye-yielding plant species. Colouring agents of these plants are derived from roots, leaves, barks, trunks or fruits. All colours of the rainbow are obtained from

plants (Cage). Natural dyes have better biodegradability and generally have a higher compatibility with the environment [3].

Natural dyes are experiencing a new beginning in the field textile coloration. They are more compatible with the environment compared to synthetic dyes because they are eco-friendly, non-toxic, non-allergenic and biodegradable. [4] Natural dyes are colorants obtained from different natural sources without any synthesizing. It includes all the dyes derived from different natural sources such as plants, animals, and minerals. There are different types of natural dyes like henna, onion, turmeric, marigold, betel nut, etc. The roots, stems, barks, leaves, berries, and flowers of various dye plants are continuously using for dyeing carpets, rugs, and clothing. Due to no substantively of most of the natural dyes, it has to apply to the substrate with the help of different mordants. [5] Even though Synthetic dyes have many benefits, it has one negative side which deluges all the benefits, and the negative side is that it is not compatible with our environment. It is the high time to reconsider the use of natural dyes. [6] In this regards, many commercial dyers already have started using natural dyes as a convenient replacement of synthetic dyes to overcome the environmental damage caused by synthetic dyes. Also, synthetic dyes such as azo dyes are found to be carcinogenic. [7]

1.1 PRESENT CONDITION OF NATURAL DYES

These days, environmental pollution can undoubtedly be regarded as one of the main problems in developed and developing countries. This is due, not just to one, but to a number of factors, such as the misuse of natural resources, inefficient legislation and a lack of environmental awareness.

Every industrial process is characterized by the use of inputs (raw materials, water, energy, etc.) that undergo transformation giving rise to products, byproducts and waste. The wastes produced at all stages of the various types of human activity, both in terms of composition and volume, vary according to the consumption practices and production methods. The main concerns are focused on the impact these can have on human health and the environment. Hazardous waste, produced mainly by industry, is particularly worrying, because when incorrectly managed, it becomes a serious threat to the environment and therefore to human health. Thus the

study of new alternatives for the treatment of different types of industrial effluent continues to be a challenge to combat anthropogenic contamination.

Amongst that of several other industries, the textile sector waste has received considerable attention in recent years, since it can generate large volumes of effluents that, if not correctly treated before being disposed into water resources, can be a problem, as previously mentioned. Effluents from the textile industry are extremely complex, since they contain a large variety of dyes, additives and derivatives that change seasonally, increasing the challenge to find effective, feasible treatments. Currently, the processes developed and available for these industries are based on methods that were designed for other waste, and have limitations when applied to textile effluents. As a consequence, these industries produce colored wastewater with a high organic load, which can contribute enormously to the environmental pollution of surface water and treatment plants if not properly treated before disposal into the water resources. The ingestion of water contaminated with textile dyes can cause serious damage to the health of humans and of other living organisms, due to the toxicity, highlighting mutagenicity of its components. [8]

1.2 ADVANTAGES OF NATURAL DYE

- **Minimal Environmental Impact** – Because they come from natural sources, natural dyes are not harmful to the environment, which makes it so appealing for consumers. Natural dyes are biodegradable and disposing them don't cause pollution.
- **Renewable** – Natural dyes are obtained from renewable sources that can be harnessed without imposing harm to the environment.
- **Color pay-off** – If you're going for a soft hue or soothing shade, natural dyes can help you achieve that look.
- **Safe** – Some natural dyes, such as carmine found in lipsticks, will not cause harm or health problems when ingested.[9]

2. OBJECTIVES OF THE STUDY

- To produce natural dye from orange peels.
- To find effect of different type of mordents.
- To find the efficiency of dyes on different cloth material.
- To know the effectiveness of natural dye.

e. To investigate whether using natural dyes is a truly sustainable alternative to chemical dyes.

3. MATERIAL

Source: Orange peels were collected from waste in clean polythene bags from kitchen of the Indus university campus.

Substrate: 100% soft cotton fabric were use as substrate .

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

Mordant: The clean scouring clothes were treated with different mordents such as Ferrous Sulphate (FeSO₄), Copper Sulphate (CuSO₄) .

3. METHODOLOGY

Methods: Extraction of colour dye was carried out by two different methods.

1. Aqueous extraction method
2. Alkaline method

Step 1-50 gm of orange peels were boiled in 500ml of distilled water at 100 C for 30 minutes.



Fig-1 Boiled orange sample

Step 2- After 30 minutes, orange peels were removed from the extraction solvent .Water content remaining was approx. 190 ml.



Fig-2 Filtered extract

Step 3- The cotton sample was dipped in the filtered extract for 24 hours.



Fig-3 cotton sample dipped in aqueous solution with mordant ferrous sulphate



Fig-4 cotton sample dipped in aqueous solution with mordant copper sulphate

Step 4-After 24 hours the cotton sample was removed and the amount of dye extracted was calculated through colorimeter

Step 5-The cotton cloth was washed with the tap water and was allowed to dry under normal temperature.

Step 6-The difference between the cotton cloth before and after washing was observed.

b. Alkaline method:

Step 1-50 gm of orange peels were boiled in 1% NaOH solution having volume of 500 ml at 100°C for 30 minutes.

Step 2-After 30 minutes the orange peels were removed from the extraction solvent.



Fig-5 Solvent sample

Step 3-cotton sample was dipped in filtered solution for 24 hours.



Fig-6 Cotton dipped in alkaline solution

Step 4-After 24 hours the amount of dye extracted from cotton sample was calculated through colourimeter

Step 5-The cotton cloth was washed with the tap water and was allowed to dry under normal temperature.

Step 6-The difference between the cotton cloth before and after washing was observed.

4. RESULTS AND DISCUSSION

To enhance the color of natural dye mordents were used. Different colour shades were obtained by using ferrous sulphate and copper sulphate .

The following results were obtained:

Table -1 Result obtained

Sr.No	Solvents	Cotton fabrics	Colorimeter reading
1	Aqueous	Good	156(F)
2	Acidic	Good	97(F)

- ❖ The amount of dye extracted from the orange with application of different mordant (aqueous method)

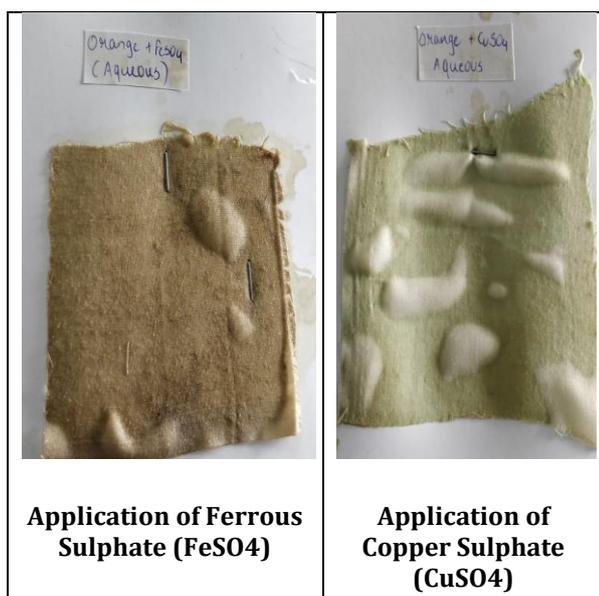


Fig-7 Dyed cotton sample of orange by aqueous extraction method

- ❖ The amount of dye extracted from the orange with application of different mordant (alkaline method)

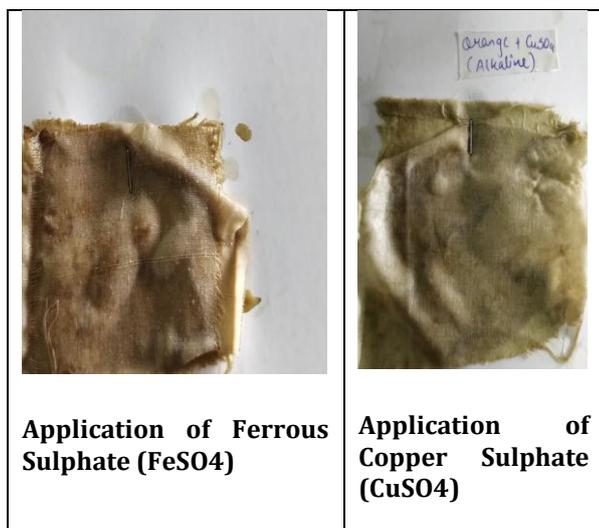


Fig-8 Dyed cotton of orange by alkaline method

5. CONCLUSIONS

Thus, results obtained from present investigation revealed that, the orange peels has the potential to be used as dyeing material. Dyes obtained from orange waste can be used as cost effective and economically commercial for various purposes. 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.

Dyes produced by orange peels along with Copper Sulphate mordant can be used when one requires soft green shade whereas the dye produce by using Ferrous Sulphate as mordant can be used to provide light to dark shades of brown. Thus orange peel, can produce variable and viable shades when used along with different mordants.

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