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Use of Kitchen Waste as Natural Dye

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In today's world, the textile industry plays a very important role in economic growth and daily life. However, along with its benefits, it has also created serious environmental problems. One of the major issues is the use of synthetic dyes, which are widely applied in fabric coloring. These dyes are often made from harmful chemicals and, when released into water bodies, they can cause pollution, damage aquatic life, and even affect human health. Because of these concerns, there is a growing need to find safer and more environmentally friendly alternatives.

Natural dyes have recently gained attention again as a sustainable option. In earlier times, people used plant-based materials to color fabrics, but these practices gradually declined after synthetic dyes became popular due to their easy availability and strong colors. Now, with increasing awareness about environmental protection, researchers are trying to bring back natural dyeing methods in a modern and practical way.

Mulberry silk, produced by the silkworm *Bombyx mori*, is one of the most elegant and widely used natural fibers. It has a smooth texture, natural shine, and excellent ability to absorb dyes. These properties make it highly suitable for natural dyeing. At the same time, using eco-friendly dyes on silk can increase its value in the market, especially as consumers are becoming more conscious about sustainable products.

An interesting and innovative idea in this field is the use of kitchen waste as a source of natural dyes. Every day, households generate a large amount of organic waste such as onion peels, fruit skins, and used tea leaves. Most of this waste is simply thrown away, even though it contains useful natural pigments. For example, onion peels have flavonoids, pomegranate peels are rich in tannins, and turmeric contains a strong yellow pigment called curcumin.

By using these waste materials for dyeing, we can reduce waste, save money, and protect the environment at the same time. This approach also supports the concept of a circular economy, where waste is reused instead of being discarded. In addition, it can be very helpful for small-scale industries and rural artisans who may not be able to afford expensive synthetic dyes.

Keeping all these points in mind, the present study focuses on using commonly available kitchen waste materials to dye mulberry silk. The aim is to develop a simple and low-cost method that can be easily adopted while also promoting sustainable practices

Materials and Methods

In this study, simple and easily available materials were used so that the method can be followed even outside advanced laboratory conditions. Mulberry silk fabric was selected as the main material because of its well-known dye absorption properties. The silk used in the experiment was already degummed, which means the outer layer (sericin) had been removed. This step is important because it helps the fabric absorb dye more effectively.

The kitchen waste materials used in this study included onion peels, pomegranate peels, used tea leaves, and turmeric waste. These materials were chosen because they are

commonly found in households and are known to contain natural coloring compounds. Instead of being thrown away, they were collected and reused for dye extraction.

Before using them, all the collected waste materials were cleaned properly to remove any dirt or unwanted particles. After cleaning, they were dried in shade for a few days. Drying is important because it helps preserve the pigment and makes the materials easier to store and use. Once dried, the materials were cut or crushed into smaller pieces so that the color could be extracted more efficiently.

The dye extraction process was carried out by boiling each material in water. A fixed ratio of material to water was maintained to keep the process consistent. The mixture was heated for about an hour at a moderate temperature. During this time, the color from the plant material slowly dissolved into the water, forming a dye solution. After boiling, the solution was filtered to remove the solid parts, leaving behind a clear colored liquid ready for dyeing. To improve the dyeing process, mordants such as alum, iron, and copper were used. These substances help the dye bind better to the fabric and also affect the final color. The silk fabric was first treated with the mordant solution before dyeing. This step was done carefully under controlled temperature conditions.

After mordanting, the silk fabric was placed into the dye solution and heated for a certain period. This allowed the fabric to absorb the color properly. Once the dyeing was complete, the fabric was removed, washed gently with water to remove excess dye, and then dried in shade.

Results

The results of the experiment showed that all the selected kitchen waste materials were capable of producing noticeable colors on mulberry silk. Each material gave a different shade depending on its natural pigment content.

Table 1: Sources of Kitchen Waste and Colors Obtained

S. No	Kitchen Waste Material	Major Pigment	Color Obtained
1	Onion peel	Flavonoids	Yellow to brown
2	Pomegranate peel	Tannins	Light brown
3	Tea waste	Polyphenols	Dark brown
4	Turmeric waste	Curcumin	Bright yellow

From the table, it is clear that different waste materials produce different natural shades. Onion peels gave warm yellow and brown colors, while pomegranate peels resulted in soft brown shades. Tea waste produced deeper and darker tones, and turmeric gave a bright yellow color.

Table 2: Effect of Mordants on Color Variation

Dye Source	Alum	Iron	Copper
Onion peel	Golden yellow	Dark brown	Olive green
Pomegranate peel	Beige	Greyish brown	Dark brown
Tea waste	Light brown	Blackish brown	Deep brown
Turmeric	Bright yellow	Mustard brown	Yellow-green

It was also observed that mordants played a major role in changing the final color. Alum generally produced brighter shades, while iron gave darker tones. Copper created slightly different and unique shades.

Table 3: Cost Analysis of Dyeing Process

Parameter	Synthetic Dye	Kitchen Waste Dye
Raw material cost	High	Very low
Availability	Market dependent	Easily available
Environmental impact	High pollution	Eco-friendly
Waste utilization	None	High

The cost comparison clearly shows that kitchen waste dyeing is much cheaper and more environmentally friendly than synthetic dyeing.

Discussion

The results of this study clearly show that kitchen waste can be successfully used as a natural dye source for mulberry silk. One of the most interesting findings is the variety of colors that can be obtained from simple household waste materials. This proves that useful resources are often present in materials that we usually consider useless.

The effectiveness of different waste materials depends mainly on the type of natural pigments they contain. For example, tea waste and pomegranate peels gave deeper colors because they contain higher amounts of tannins and polyphenols. These compounds have a strong ability to bind with silk fibers, resulting in better dye absorption.

Mordants were found to play a very important role in this process. Without mordants, natural dyes may not attach properly to the fabric. Different mordants not only helped in fixing the dye but also created different shades from the same dye source. This makes the process more flexible and useful for producing a variety of colors.

From an environmental point of view, this method is very beneficial. It reduces the use of harmful chemicals and also helps in managing kitchen waste. Instead of throwing away organic waste, it can be reused in a productive way. This supports sustainable living and reduces pollution.

Economically, this method is highly suitable for small-scale use. Since the raw materials are almost free, the overall cost of dyeing is very low. This can be especially helpful for rural communities, students, and small textile units.

Conclusion

In conclusion, the study proves that kitchen waste materials can be effectively used as natural dyes for mulberry silk. The method is simple, low-cost, and environmentally friendly. Different types of waste materials produce a range of colors, and the use of mordants helps in improving the final result. This approach not only helps in reducing environmental pollution but also promotes the idea of recycling and sustainable use of resources. It has good potential for practical use, especially in eco-friendly textile production.