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**Renu Singh**  
Junior Research Fellow,  
Department of Home Science,  
University of Allahabad, Uttar  
Pradesh, India

**Dr. Sangita Srivastava<sup>2</sup>**  
Professor and Head, Department  
of Home Science, University of  
Allahabad, Uttar Pradesh, India

## Application of natural dye obtained from peel of black cardamom on silk fabric

**Renu Singh and Dr. Sangita Srivastava**

### Abstract

**Introduction:** These days the environmental protection has become a challenge for the textile industry because it uses a fairly large number of chemicals for dyeing and printing. These chemicals are harmful for both human as well as environment. Synthetic dyes suffer from several draw-backs. Some of the synthetic dyes which are even carcinogenic and mutagenic have been banned. In this era of green minded consumer, interest in natural dyes has grown mainly because natural dyes have been shown to possess health-promoting and eco-friendly properties. In the present study, an attempt has been made to provide a new valuable resource of natural dye to the textile industry. Natural dye was extracted from peel of black cardamom (*Amomum subulatum*). Mordanting with alum was carried out by three different methods i.e. pre, simultaneous and post mordanting each in two mediums i.e. alkali and aqueous. The dye fastness of dyed samples has been investigated using gray scale assessment method. The results for dyeing are very promising and hopeful.

**Keywords:** Natural dyes, mordant, alum, black cardamom.

### Introduction

Textile dyeing plays a very important role in textile processing industry. The widely and commonly used synthetic dyes impart strong colour but causes carcinogenicity and inhibition of benthic photosynthesis<sup>[1]</sup>. Finding of researches conducted in recent years showed that chemicals used in synthetic dyes may contain toxic elements such as benzidine, aryl amine, lead, cadmium, zinc, mercury, formaldehyde, pentachlorophenol and halogen carrier etc. Use of such dyes in textiles is associated with environmental degradation as well as hazards on health of human and other living beings viz creating skin cancer, skin irritation, lungs problem and allergy. A number of synthetic dyes have listed as carcinogenic and toxic for human health. As per the provisions of the German ordinance it will be prohibited to import, sell, market or distribute textile goods, which are manufactured using these banned dyes.

Due to such negative impact of synthetic dyes researches in the field of textile dyeing has been focused on preparation of natural dyes. In the present trend of work culture, safety and eco-requirements will continue to dominate the trade and the producers will need to understand the changes that need to be done to satisfy these requirements.

The use of nontoxic and eco-friendly natural dyes on textile has become a matter of significant importance because of the increased environmental awareness in order to avoid some hazardous synthetic dyes<sup>[3-4]</sup>.

In many of the world's developing countries, natural dyes can offer not only rich and varied sources of dyestuff but also the possibility of an income through sustainable harvest and sale of these plants<sup>[2]</sup>. Dyes of natural origin are environment friendly in nature and have no side effect on skin.

Natural dyes are creating demand not only in textile industry but in foodstuffs, leather and cosmetics also. Recently, a number of commercial dyers and small textile export houses have started looking at the possibilities of using natural dye for regular basis dyeing and printing of textiles to overcome environmental pollution caused by the synthetic dyes<sup>[6]</sup>.

The present study is a step towards finding the solution for this problem. Black Cardamom (*Amomum subulatum*) is selected as resource of natural dye because it is found in abundance in India and also it has antibacterial property. Studies shows that *Amomum subulatum* possesses promising antioxidant, it may be due to polyphenol and other

### Correspondence

**Renu Singh**  
Junior Research Fellow,  
Department of Home Science,  
University of Allahabad, Uttar  
Pradesh, India

chemical constituent present in extract [5].

### Methods and Material

**Source:** Peel of black cardamom was used as a source of natural dye because it is an industrial waste. Utilization of such waste will not only help in reducing environmental pollution but also beneficial for growth of our economy.

**Substrate:** Pure mulberry silk fabric was used as a textile material because of its unique properties. Silk is amphoteric in nature and has good absorbency and thus has good affinity for dyes.

**Chemicals Used:** Alum or hydrated potassium aluminium sulfate (potassium alum) was used for mordanting.

**Locale of the Study:** The study was conducted in the chemistry laboratory of Department of Home Science, University of Allahabad (U.P.). Required material for experimental work i.e. pure mulberry silk fabric and black cardamom were brought from the market.

### Experimental Procedure

Laboratory experiments were carried out under following phases:

#### Preparation of sample and dye powder:

Degumming of silk was done by dipping it into 0.5 % of mild detergent solution having 50°C temperature. It was stirred gently for 30 minutes. Silk fabrics having one gram weight of required number were prepared by weighing. Black cardamom was dried in shade and peel was separated followed by grinding to make into fine powder. Dye powder was used for dyeing purpose.

### Dyeing of the samples

Two types of dyeing medium were prepared i.e. alkaline and aqueous. For preparation of alkaline dye bath 1 ml of sodium carbonate was dissolved in 100 ml of distilled water. Only 100 ml distilled water was used for extraction of dye, in aqueous medium.

Prepared dye powder was soaked in each of the dyeing medium. The pre-soaking time was one hour. The extract was used keeping. M:L ratio as 1:100 for dyeing. The dye was extracted by boiling the solutions for an hour. Extracted dye solutions were then filtered. Silk samples weighing one gram each were added to each of the prepared dye solution. Dyeing was carried out for an hour. The samples were left immersed in the dye solution for 24 hours.

### Mordanting of samples

Alum, also called potash Alum  $[Al_2K_2(SO_4)_4]$  was used for mordanting of silk fabric. 1 gm of alum in 100 ml of water was used for mordanting 1 gm of fabric. Mordanting time was one hour. Mordanting was carried out by three different methods i.e. pre, simultaneous and post mordanting each in alkaline and aqueous medium. After mordanting and dyeing, the fabrics were tested for colour fastness.

### Results and Discussion

The results obtained are reported and discussed in the following sections:

**Colours of Dyed Silk Samples:** The different colours were developed by using different methods of mordanting. Alkaline and aqueous mediums were used for extraction and application of dye on silk fabric. Obtained colours are listed in table 1.

**Table 1:** Colours obtained with different mordants using black cardamom dye

Dye Source	Mordant	Methods of Mordanting	Medium of Mordanting	Shades of Colour
Peel of black cardamom	Alum	Pre	Alkaline	
			Aqueous	
		Simultaneous	Alkaline	
			Aqueous	
		Post	Alkaline	
			Aqueous	

### Colour Fastness Tests

#### a). Colour fastness to Light

In this colour fastness test, it was found that mordanting improved fastness to light because most of the samples showed no colour fading and no change in colour but pre mordanted fabric dyed in aqueous medium showed slight fading in colour. Light fastness rating was 5 for each dyed samples except pre mordanted fabric dyed in aqueous medium (4/5).

**Table 2:** Rating of light fastness of mordanted samples dyed with peel of black cardamom dye

Dye Source	Mordant	Methods of Mordanting	Medium of Mordanting	Light fastness Grade
Peel of black cardamom	Alum	Pre	Alkaline	5
			Aqueous	4/5
		Simultaneous	Alkaline	5
			Aqueous	5
		Post	Alkaline	5
			Aqueous	5

**b). Colour fastness to washing**

Table 3 reveals that sample dyed in aqueous medium with pre and simultaneous mordanting showed much change in colour

4 and 4/5 respectively. Pre mordanted fabric dyed in aqueous solution showed staining (4/5) on silk while all the samples showed no staining on cotton.

**Table 3:** Rating of washing fastness of mordanted samples dyed with peel of black cardamom dye

Dye Source	Mordant	Methods of Mordanting	Medium of Mordanting	Wash fastness grade		
				Change in colour	Staining on cotton	Staining on silk
Peel of black cardamom	Alum	Pre	Alkaline	5	5	5
			Aqueous	4	5	4/5
		Simultaneous	Alkaline	5	5	5
			Aqueous	4/5	5	5
		Post	Alkaline	5	5	5
			Aqueous	5	5	5

**c). Colour fastness to crocking**

Overall, it can be concluded from the result that, colour fastness against dry crocking is better than wet crocking. Pre and Simultaneous mordanting in both the medium were found

excellent towards both dry and wet crocking. In wet crocking post mordanted silk fabric dyed in alkaline and aqueous medium showed staining on cotton fabric (4/5).

**Table 4:** Crocking fastness of mordanted samples dyed with black cardamom dye

Dye Source	Mordant	Methods of Mordanting	Medium of Mordanting	Crocking fastness grade			
				Dry crocking		Wet crocking	
				Change in colour	Staining on Cotton	Change in colour	Staining on Cotton
Peel of black cardamom	Alum	Pre	Alkaline	5	5	5	5
			Aqueous	5	5	5	5
		Simultaneous	Alkaline	5	5	5	5
			Aqueous	5	5	5	5
		Post	Alkaline	5	5	5	4/5
			Aqueous	5	5	5	4/5

**d). Colour fastness to perspiration**

It was found that post mordanted samples dyed with peel of black cardamom exhibit good perspiration fastness. Table 5 reveals that alkaline perspiration fastness was better than aqueous perspiration. Pre and simultaneous mordanted

samples dyed in aqueous medium showed change in colour (4/5 in acidic perspiration and 3/4 as well as 4 in alkaline perspiration). In acidic perspiration test, these samples also results in staining on silk fabric (4/5).

**Table 5:** Perspiration fastness of mordanted samples dyed with black cardamom dye

Dye Source	Mordant	Methods of Mordanting	Medium of Mordanting	Perspiration fastness grade					
				Acidic perspiration			Alkaline perspiration		
				Change in colour	Staining		Change in colour	Staining	
Cotton	Silk	Cotton	Silk						
Peel of black cardamom	Alum	Pre	Alkaline	5	5	5	5	5	5
			Aqueous	4/5	5	4/5	3/4	5	5
		Simultaneous	Alkaline	5	5	5	5	5	5
			Aqueous	4/5	5	4/5	3/4	5	5
		Post	Alkaline	5	5	5	5	5	5
			Aqueous	5	5	5	4	5	5

**Conclusion**

It can be concluded from the above results that mordanting done in alkaline medium improves the colour fastness. Some samples showed change in colour when dyed in aqueous medium. Overall, the serviceability of the dyed fabric with black cardamom was found good. Cost of the dye is very low as it is made from byproduct of black cardamom. It is eco-friendly because it is made from natural raw material. So, it may be used for production of dyed textiles on a large scale.

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