



# Advances in Natural Dyes for Environmental Protection Degradation and Remediation

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Editors



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## CHAPTER 10

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# Challenges of Using Natural Dyes in the Global Market

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### ABSTRACT

Since ancient times, the use of natural dyes in various established and emerging applications has been prevalent due to their unique properties. Consequently, the industry associated with their production, processing, and marketing has been flourishing. Despite the historical contributions it has made to the development of human civilization, the adverse effects resulting from their indiscriminate use cannot be ignored. These challenges pose a significant threat to human health, textile pollution, and overall degradation, necessitating the implementation of efficient and effective strategies for remediation. These remedial measures must be employed to prevent environmental degradation associated with their usage. These challenges alone make it challenging to advance further and establish a strong presence in the global market. Therefore, it is crucial to prioritize overcoming these challenges in order to enhance their role and applications on a sustainable scale in the global market.

### 10.1 INTRODUCTION

Dyeing is an ancient art form that predates our civilization. Dyed textile remains discovered during archaeological digs in various locations across the world provide evidence for the use of dyeing in ancient cultures. From

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ancient times until the eighteenth century, natural dyes were exclusively used to color fabrics. Natural dyes, as the name implies, are derived from natural materials. A variety of textile materials were dyed using colorants sourced from valuable natural resources, including plants, living animals, mineral deposits, and microbial origins (Geelani et al., 2021). The practice of dyeing dates back to the dawn of civilization; fragments of dyed textiles found during archaeological excavations in different parts of the world serve as proof of this (Geelani et al., 2015). From ancient times until the eighteenth century, textiles were exclusively colored using natural dyes (Adrosko et al., 1971; Anon et al., 2001; Agarwal & Tiwari, 1989).

Natural dyes are derived from natural materials, as the name suggests. Various textile fabrics have been colored using coloring agents obtained from plants, animals, minerals, and microorganisms. Many regions around the world have their own unique traditions of using natural dyes, making use of local resources. However, the use of natural colors declined with the advent of synthetic dyes in the late 19<sup>th</sup> century. Synthetic dyes became more popular due to their easy availability, simpler application techniques, consistent color results, and superior colorfastness compared to natural dyes. As a result, synthetic dyes have largely replaced natural dyes in textile production, with only a few isolated areas continuing the practice of using natural colors. Natural dyes are considered environmentally friendly as they are biodegradable, reusable, gentle on the skin, and may even have potential health benefits (Chattopadhyay et al., 2013; Datta et al., 2013; Grifoni et al., 2011). Almost all varieties of natural fibers can be dyed using natural dyes. Recent studies have shown that some synthetic fabrics can also be dyed with them. Natural dyes are not only used for textiles, but also for coloring food, medications, handicrafts, toys, and leather tanning. Many plants that produce dye are also used as medicines in various traditional medical systems. However, the use of natural dyes presents several challenges and limitations. The textile industry currently requires approximately 3 million tons of dyestuff, making it difficult to incorporate natural colors into conventional textile processes. This is due to the need for agricultural land to support livestock and feed the growing global population. It is important that the production of dyes does not compromise biodiversity, and the durability of natural colorants is a significant concern. This chapter explores various issues related to the use of natural pigments in textiles, including potential sources, chemistry, extraction methods, application techniques, and sustainability concerns (Samanta & Agarwal, 2009; Sharma et al., 2013). The chapter also provides a detailed timeline of the primary adverse impacts of promoting natural dyes,