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Ahmet Gürses  
Metin Açıkyıldız  
Kübra Güneş  
M. Sadi Gürses

# Dyes and Pigments



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Ahmet Gürses · Metin Açıkyıldız  
Kübra Güneş · M. Sadi Gürses

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Ahmet Gürses  
Kazım Karabekir Eğitim Fakültesi  
Atatürk Üniversitesi  
Erzurum  
Turkey

Kübra Güneş  
Atatürk University  
Erzurum  
Turkey

Metin Açıkıldız  
Kilis 7 Aralık University  
Kilis  
Turkey

M. Sadi Gürses  
Koç University  
Istanbul  
Turkey

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# Preface

Nowadays, dyes and pigments are of great interest in terms of scientific research and practical applications. This book has been written to create the concise practical overview of colorant substances by offering a comprehensive introduction devoted to the historical development of dyes and pigments.

In this context, Chap. 1 is devoted to the historical development of dyes and pigments. Chapter 2 predominantly examines the structures of dyes and pigments with the formation mechanisms of color and the chemistry of dyes. Hence, this chapter starts with the brief information about the chemical structures of typical colorants and ends with a comprehensive analysis of the color phenomenon.

The extensive information about different colorants and their structural characteristics has a critical importance in the creation of novel dye types and their application fields and also in the preparation of new dye formulations which cover nanotechnological applications. Therefore, Chap. 3 highlights the differences between dyes and pigments by considering the main classifications of the dyes and pigments.

Chapter 4 is devoted predominantly to the dyeing methods including several modern and traditional techniques.

Finally, in Chap. 5, a wide range of dyes and pigments are discussed in the context of green chemistry with environmental and health aspects by considering their negative results related with their use.

To sum up, this book is a detailed review particularly about dyes, pigments, and color, and even paints.

We believe that this book containing many figures, schemas, and numerous relevant references in each chapter would be an essential reference source for the readers working on the researches and applications related to dyes, pigment, and dyeing.

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Ahmet Gürses  
Metin Açıkyıldız  
Kübra Güneş  
M. Sadi Gürses

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# Chapter 1

## Historical Development of Colorants

**Abstract** Color is one of the elements of nature that makes the human life more aesthetic and fascinating in the world. Plants, animals, and minerals have been used as primary sources for colorants, dyes or pigments since ancient times. The first fiber dyes known to be used in prehistoric times consisted of fugitive stains from berries, blossoms, barks, and roots. This chapter is devoted to an historical introduction to the colorants, taking into account of the chronological developments in dyeing processes and the origins of dyes used. Even today, the dyeing using natural materials is applied as an adjunct for hand spinning knitting and weaving but it has remained as a living craft in many traditional cultures of North America, Africa, Asia, and the Scottish Highlands. The new discoveries about the science of color have also led to many industrial innovations and a sharp fashion change. Scale insects have long been used to produce crimson-colored dyes. Many plant pigments are used as dyes. Madder has been utilized since times as a red vegetable dye for leather, wool, cotton and silk. Indigo is a natural dye that is structurally related to betalains. Tyrian purple, which is an ancient dye, has been extracted from shellfish of the *Murex* genus.

**Keywords** Natural dyes and pigments · Madder · Murex · Tyrian purple · Kermes · Cochineal · Woad · Indigo · Mauveine · Lapis lazuli

### 1.1 Introduction

In recent years it is observed an increased interest to dyes that are derived from natural sources, especially among artists working on textiles (Sequin-Frey 1981). This chapter provides an historical introduction to the colorants, taking into account of the chronological developments in dyeing processes and the origins of dyes used.

Plants, animals, and minerals were known as the primary sources for colorants, dyes or pigments, until the middle of the nineteenth century (Vankar 2007). The first fiber dyes known to be used in prehistoric times consisted of fugitive stains from berries, blossoms, barks, and roots (Das 2011; Sharif 2007). They are early examples