



ESSENTIAL CHEMISTRY AS COLORANTS OF INTEREST IN ARCHAEOLOGY

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ABSTRACT

This paper presenting some of the chemistry behind the colour of dyes and how the target material, for example a fibre, influences the method of dyeing and the dye used. Organic Dyes in chemistry plays an important role where color is an important feature of a manufactured product. Hereby, we made an attempt to explain possible chemistry used in archaeology with research in this area.

Keywords: Organic Dye, Colorants, SERS, Debromination, Chromatography

Introduction

Paintings, sculptures and several other artifacts that are part of our cultural heritage, including textiles, books, furniture, archaeological objects and the organic residues found in association with them, often contain a great variety of both natural and synthetic coloring substances¹⁻³.

Chemical investigation of such materials is of great interest to art historians, restorers and art conservators. In fact, the analysis of ancient dyes can be of help in revealing what kind of substances were available in particular periods and geographical areas, providing valuable data about the historical context of a work of art, the lifestyle and the technical knowledge reached by a certain population in a given historical age, the provenance of textile materials, pigments, dyestuffs and colored artifacts, shedding light on the possible interactions between different cultures as well as the trade routes and commercial transactions which may have allowed the usage of a particular colorant far from its geographical source.

Moreover, discovering the nature and the origin of the coloring substances employed in the production of a work of art can provide precious information regarding its original color and appearance, thus offering new insights into the artist's choices and original intention, the techniques used and the dates ante quem and post quem the art object was produced, possibly leading to the uncovering of falsifications and forgeries.

Furthermore, scientific analysis applied to the study of art materials and, specifically, of pigments and dyes, may contribute to assess suitable conservation and restoration procedures to be applied to paint defects and degraded pigments in works of art of any kind; in fact, time, environmental conditions and several other circumstances unavoidably cause damage and deterioration to art objects and artifacts, which therefore require careful conservation to be safeguarded as important elements of our cultural heritage. The identification of historical dyes is currently one of the most challenging tasks in the chemical investigation of art materials, for three main reasons. First of all, colorants⁴⁻⁶ in works of art and archaeological textiles are usually included in complex matrixes such as paint layers or cloth fibers, where they are present in mixture with other substances, e.g. binding media or mordants, and in very low concentrations due to their high tinting power. Besides, sampling of art objects is always limited to microscopic fragments, when at all allowed. An additional analytical challenge is posed by the remarkable susceptibility to deterioration of organic materials, which can undergo a number of chemical degradation processes leading to the formation of specimens with a different molecular structure in comparison to the primary organic dye.

In this regard, a few cases reported in the literature are dealing, for instance, with the detection of products such as **2,4-dihydroxybenzoic acid** and **2,4,6-trihydroxybenzoic acid** deriving from morin in samples dyed with old fustic⁷ and from luteolin in weld and dyer's broom⁸; similarly, debromination upon ageing has been evidenced in indigoid components of purple^{9,10}.

ISSN 2454 - 308X



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