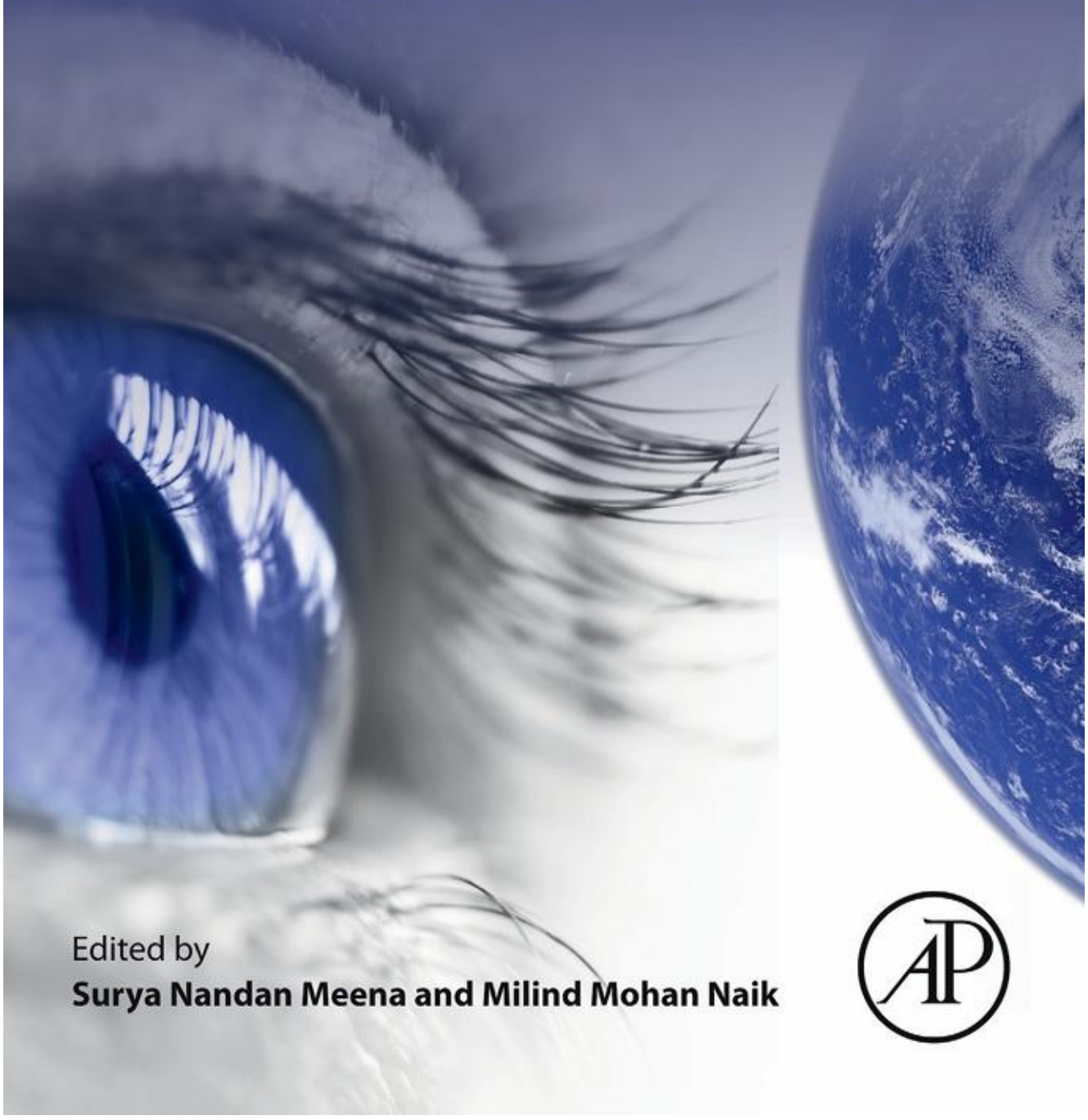
Advances in Biological Science Research

A Practical Approach



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Chapter 20

Photocatalytic and microbial degradation of Amaranth dye

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20.1 Introduction

Dyes are one of the most fascinating chemical compounds because of their unique chemical structure, presence of specific functional groups called *chromophores*, and a network of extended conjugation system that, together, allows harvesting photon energy from the visible spectrum of solar radiation and re-emit light as complementary colors. These colored dyes have now become an inherent and integral part of our daily food. *Amaranth* is one such cationic *azo* dye having dark red to purple color and is widely used as an additive in the food and cosmetic industries. The name Amaranth is derived from the plant Amaranthus; belongs to the kingdom: *Plantae*; clade: *Angiosperm*; family: Amaranthaceae; and genus: *Amaranthus*. Some of the edible species of Amaranthus are cultivated as leafy vegetables and pseudo cereals whereas others are used as ornamental plants [1]. The chemically synthesized Amaranth dye is commonly referred to as Acid Red 27 and Food Red 9, while the accepted nomenclature as per IUPAC is Trisodium (4E)-3-oxo-4-[(4-sulfonato-1-naphthyl)hydrazono]naphthalene-2,7-disulfonate.

Amaranth dye was traditionally extracted from the Amaranthus plant. In more recent years, it is artificially synthesized on an industrial scale, as a trisodium salt (Fig. 20.1), with improved water solubility and dyeing efficiency for fabrics, leather, paper, etc., and it reached a million-dollar mark. In the 20th century it was one of the most widely used food colorants in the United States [2]. However, the untreated and uncontrolled emission of Amaranth dye waste in river streams, owing to its complex aromatic structure, photo stability, and low biodegradability, resulted in its accumulation in water bodies, leading to adverse effects on living systems. In 1971, the first report of the possible carcinogenic effects of Amaranth appeared in the Soviet Union [3]. Since then, several research groups have evaluated the toxicity impact of azo dyes, and Amaranth in particular. For instance, Tsuda et al. [4] conducted genotoxicity

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