Porphyrinoids Power: From Water Purification to Light-Activated Therapies

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The rise of antimicrobial resistance, increasing cancer incidence, and water pollution significantly impact public health and ecosystems globally. Porphyrins and their analogs are versatile compounds suitable for both medical and environmental applications. The chemical fine-tuning these macrocycles allows them to address critical issues as photosensitizers (PS) in photodynamic therapies and as ligands in adsorption processes.

The incorporation of a positively charged porphyrin into starch-based films resulted in improved physical and mechanical properties. These films effectively killed *Escherichia coli* bacterial cells when exposed to light. Even more promisingly, *in vitro* studies using human microvascular endothelial cells (HMEC) and human dermal fibroblasts (HDF) indicated the films' potential for enhancing wound healing without light requirement. This paves the way for the development of biocompatible wound dressings with both antimicrobial and healing properties.

The incorporation of thioglycerol moieties into the core of porphyrin and chlorin derivatives has resulted in the development of new and efficient photodynamic therapy (PDT) agents. These PS were evaluated against the human bladder cancer cell line UM-UC-3, suggesting that the singlet oxygen generation capability and subcellular localization of the PS play key roles in the photodynamic approach.

Porphyrins with thiopyridyl binding anchors were grafted onto the surface of silica particles allowed for the preparation of new and efficient adsorbents. These organic-inorganic hybrids demonstrated significantly improved adsorption capabilities for metal cations, particularly Cu(II), a harming human health and environment metal at high levels (> 1.3 ppm). The adsorption capacity of these prepared adsorbents is remarkably higher compared to other ligands supported on silica-based adsorbents, even in complex matrices such as industrial wastewater.

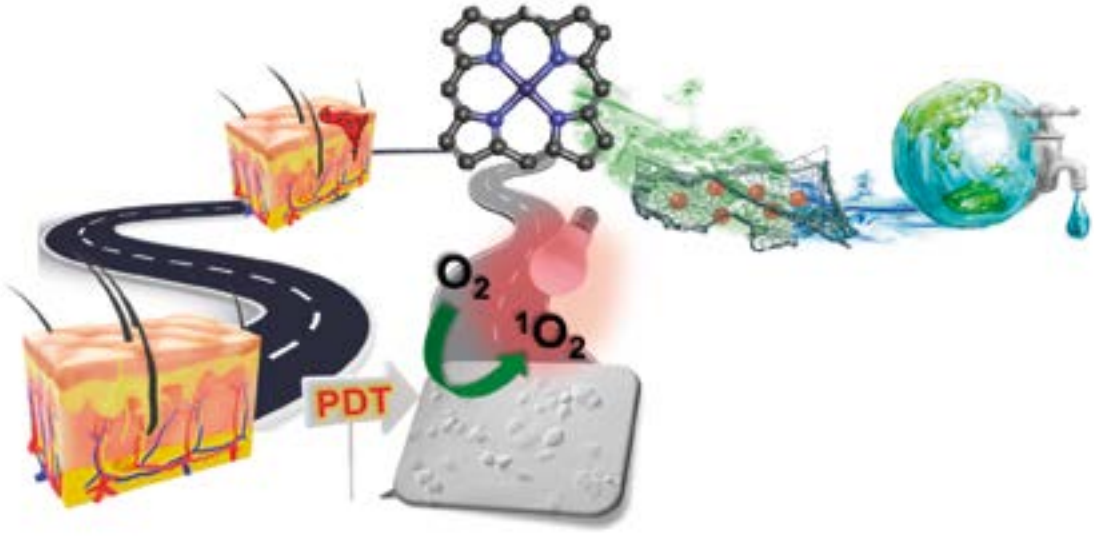

FIGURE 1
Porphyrin derivatives as versatile photosensitizers for light-activated therapy approaches and as ligands for water remediation.