Role of Specific Light Exposure on Cholesterol Photosensitized Oxidation with Zinc Phthalocyanine

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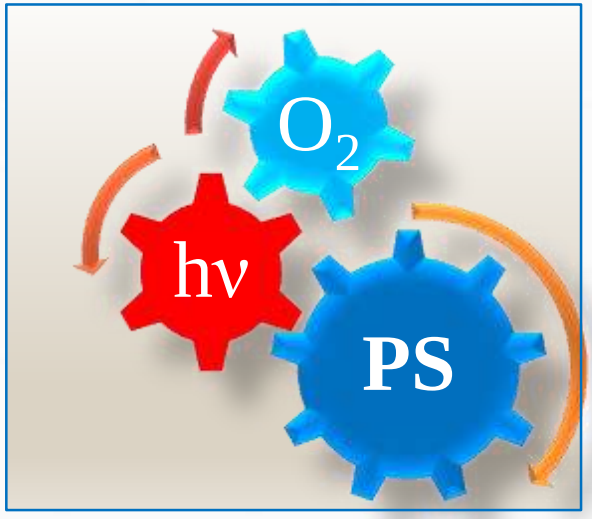
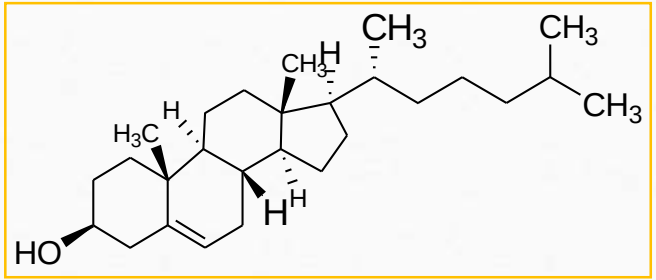
INTRODUCTION

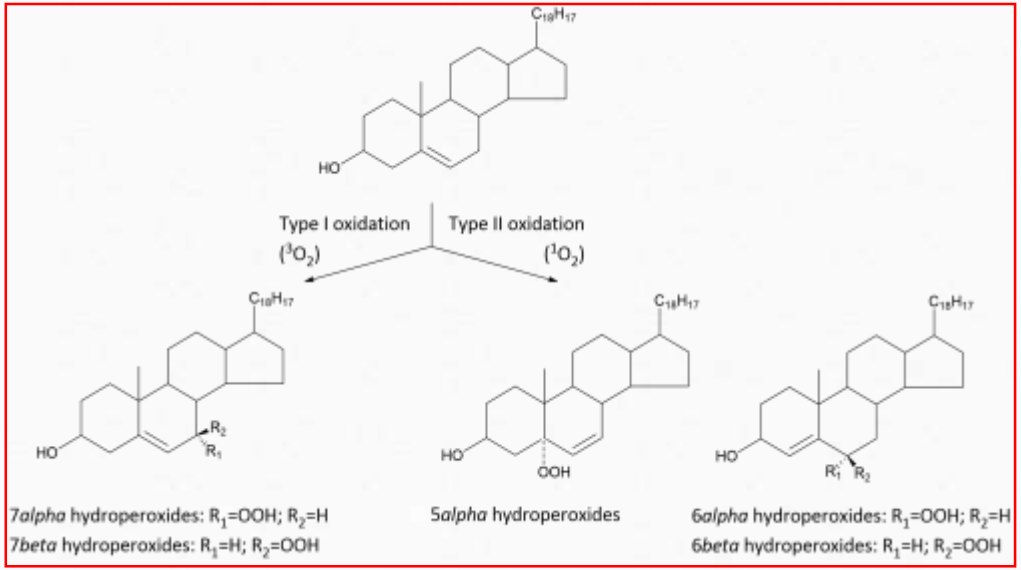


The photosensitized oxidation of biomolecules has curative impact which is used in the so called photodynamic therapy (PDT). The advantage of PDT is effective outcome in circumstances of resistance towards conventional drugs for bacterial infections and in cancer treatment. The low accidental of development of resistance features PDT method as an up-to-date alternative approach. The mechanism of PDT action involves the interaction of a light-sensitive compound - photosensitizer (PS) with target pathological tissue at suitable light exposure (hν). Upon irradiation, PS undergoes transition to singlet and triplet excitation states and the last can interact sufficiently with oxygen. This leads to generation of highly reactive oxygen species but mainly singlet oxygen with final outcome the cells' inactivation. It occurs the oxidation of the target cell ingredients (proteins, lipids and etc.).

Cholesterol as a target molecule in PDT method

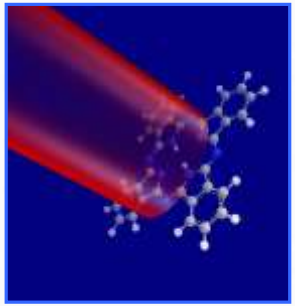
Cholesterol belongs to lipids with vital function for the living organisms. It is considered as an essential for vessels and as a part of the cells membranes with role in maintaining the membrane fluidity and permeability.

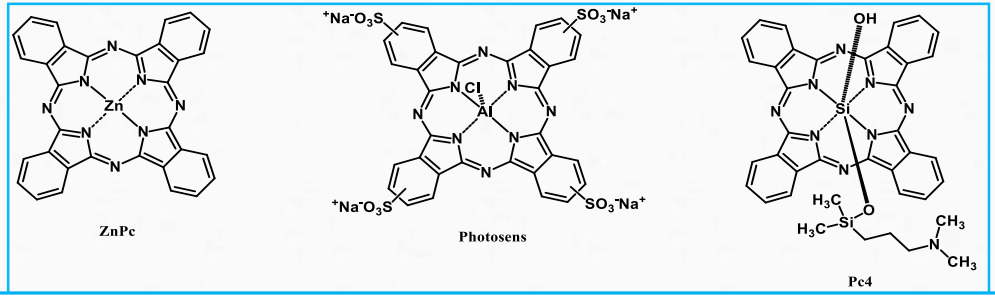




Scheme 1. Products of the oxidation of cholesterol (modified version).

Phthalocyanines as PDT photosensitizers



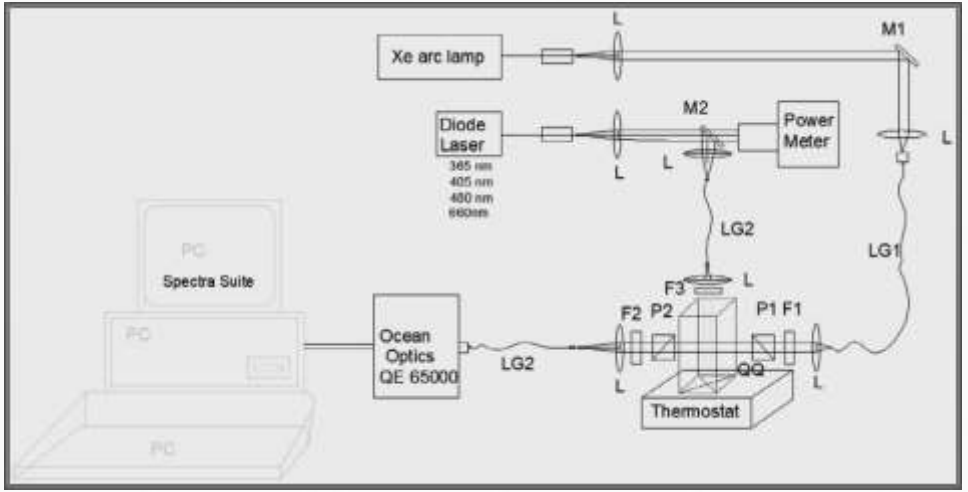


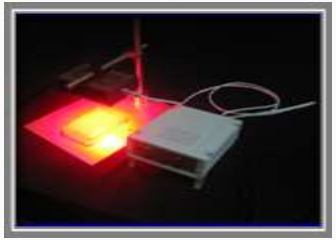
Phthalocyanines (Pcs) are well documented as effective photosensitizers for several PDT applications. The planar ring Pc heterocyclic molecule has chemical structure which facilitates the far red absorption (670 - 740 nm) which do not overlap the spectra of the native cellular chromophores (280 - 620 nm). Moreover the high molar absorptivity within the phototherapeutic window (630 - 850 nm) allow their usage of micromoles for effective outcome. The clinical PS are recognized with the lack of target tissue selectivity, high skin photosensitivity and long time of release consider the further research for improvement of the Pc structures.

OBJECTIVES

The aim: Comparative evaluation of the photosensitized oxidation of cholesterol as a substrate molecule by photosensitization with phthalocyanine zinc complex.

Materials and Methods: Unsubstituted Zn(II) phthalocyanine (ZnPc) was applied in a range of concentrations. The photosensitized oxidation was investigated in the dark and upon irradiation with two light sources, UV lamp with spectra between 205 nm and 365 nm and red light emitting diode (LED) at 665 nm at different time of exposure. The concentrations between 0.7 and 0.07 nM were used to evaluate ZnPc efficiency in photosensitized oxidation of cholesterol. The results are presented as peroxidation index vs. Pcs concentrations and the light doses.

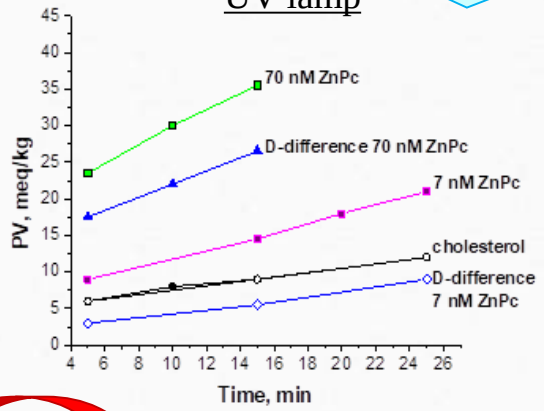




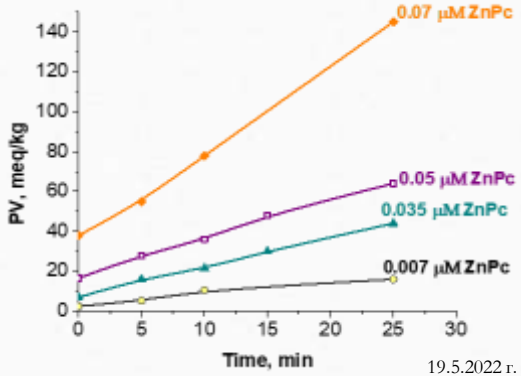
RESULTS

The cholesterol appears in highest amount in malignant than in normal cells and is called molecular anchor in tumor cells. The specific light initiation with UV and Vis red spectra of irradiation from a red-light emitting diode (LED 665-nm) and UVC lamp (max at 253 nm) on the incubated Zn(II)-phthalocyanine (ZnPc) suggested a significant photooxidation ability of ZnPc and red spectrum at 665-nm of irradiation. The photooxidation effect was observed only with UVC light. The addition of ZnPc in nanomolar concentrations leads to significant enhancement of the oxidation as was seen by the amount of the primary products which have been produced as well during photosensitization.

UV lamp



LED 665-nm



CONCLUSIONS

The main reaction product during photosensitization with phthalocyanine dyes is known to be singlet molecular oxygen. This is oxygen in its exited state which as a short-living and short-distance crossing molecule has high oxidation potential. The present study compares two irradiation light spectra with maximum at 254-nm and 665-nm for their efficiency in the photosensitized oxidation of cholesterol. The high values obtained for the primary oxidation products with LED 665-nm suggested the potential of PDT procedure for effective biodegradation of cholesterol as molecular anchor in tumor cells.

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