

The objective of the project

The increasing resistance of microbes to commonly used drugs is a serious problem of our time. Hospital germs in particular have developed strains against which practically every current antimicrobial agent is ineffective. Of great concern to the clinical and healthcare communities is the rise in fungal infections, which are resistant to conventional antifungal drugs, as well as increasing reports of resistance development in patients toward antifungal agents. Further, most conventional antifungal agents do not completely destroy the fungi but merely inhibit their growth, which may lead to future infections. These trends necessitate the urgent development of suitable alternatives to the limited selection of available antifungal agents.

One such alternative is a photodynamic inactivation of fungi (PDI), treatment that combines a topically applied formulation containing a light-activated drug, called photosensitizer with visible light to destroy fungal cells while leaving surrounding tissue unharmed. The formulation is applied directly to skin or mucous membrane, a special blue or green light is then shone on the site to activate this light sensitive compound. This results in eradication of fungal biofilm with little or no damage to the surrounding healthy cells.

To enhance the PDI treatment, we will enclose photosensitizers in nanosized micellar carriers, that carry cationic charges. By combining antimicrobial photosensitizers with biocompatible nanocarrier it's possible to ease the transport of photosensitizer through a rigid barrier of biofilm and consequently induce the formation of pores in microbial membranes, which promote the penetration of photosensitizers into the microbial cells. This approach facilitates damage to the fungal cells, enabling the fungi to be destroyed at lower photosensitizer concentrations.

The basic research to be carried out

Few studies published so far gave no clear answer in respect to how to optimize carrier properties in respect to high antifungal activity. The project will explain the role of carriers' size, surface charge and release rate in photo-killing of model fungus *Candida albicans*. Previously, various *C. albicans* strains have been harvested from patients with compromised immune systems, treated in one of hospitals in Lublin. Biofilms of these strains will be cultured and subjected to treatment with nanocarriers coupled to photosensitizers. It will allow us to figure out which structural properties of the nanocarriers safeguard high antifungal activity.

Reasons for choosing the research topic

The results will broaden the current understanding of mixed micelles as a novel nano-drug delivery systems. Results will help to establish a platform for the development of new antifungal photodynamic agents.