

## ABSTRACT

The dynamic development of various branches of medicine and pharmacy and the emergence of new visions of prevention and alternative therapies for various diseases provide opportunities to use textile medical products with carriers of various active substances. Their therapeutic effect may occur through direct contact with skin lesions and indirectly, where medicinal substances penetrate the capillary network located in the deeper layers of the skin and reach the bloodstream.

The aim of the research is to develop and characterize the components and the final product – functional textiles using transdermal systems for delivering active substances. The hypothesis of the submitted doctoral dissertation is that "it is possible to produce textile materials containing microcapsules with nanoparticles with an active substance as therapeutic textiles for delivering the drug substance transdermally."

The research scope of the doctoral thesis included the following tasks:

1. Selection of active substances that play an important role as therapeutic agents in selected ailments (e.g. diabetic foot or cancer), *Ginkgo biloba* extract (GBE) was selected.
2. Selection of polymers that are the matrix for the deposition of bioactive substances in nanoparticles (chitosan salt was selected) and in microcapsules (first alginate and then ethylcellulose).
3. Development of a method for obtaining and physicochemical characterization of nanoparticles loaded with GBE – Ch(GB)NP (methods used: ion gelation method, size and polydispersity index (PDI) analysis using the Zetasizer Nano ZS device (Malvern, UK), FTIR-ATR analysis, microbiological tests for bacterial and fungal strains).
4. Determination of the release of extract from nanoparticles in various research media (using UV-VIS spectrophotometric technique).
5. Preparation and characterization of microcapsules containing GBE or nanoparticles (methods used: external ionic gelation method, solvent evaporation method from emulsion, SEM microscopy).
6. Determination of the release of extract from microcapsules with GBE or nanoparticles in various research media (using UV-VIS spectrophotometric technique).
7. Development of methods for applying microcapsules with the active substance to a textile carriers (methods used: microcapsule immobilization technique using chitosan glue).
8. Biological tests on normal and cancer cell lines (MTT cytotoxicity test).

9. Determination of the penetration of nanoparticles with extract contained in microcapsules attached to a textile carrier through a membrane with a pore size similar to pores in the skin (according to own procedure).

Chitosan nanoparticles containing GBE were obtained and characterized in terms of morphology and physicochemical properties. It has been proven for the first time that Ch(GB)NP have cytotoxic activity against the cancer cells used (PEA1 and HeLa) and at the same time have no activity against normal cells (HGF-1) and also show antibacterial and antifungal activity against selected strains of bacteria and fungi. .

Multicore microcapsules with an alginate or ethylcellulose shell with encapsulated GBE or Ch(GB)NP were obtained, which were also characterized in terms of morphology and size. Studies on the release of *Ginkgo biloba* extract from nanoparticles and various types of microcapsules into two research media were carried out and it was shown that more of the extract is released into physiological saline than into water in the first 24 hours of the study and then the release of the extract either stabilizes or slowly increases.

Two types of functional cotton knitted fabric were obtained. The first type includes knitted fabric to which ethylcellulose microcapsules with closed *Ginkgo biloba* extract have been immobilized using chitosan glue. This type of cotton knit fabric is well described in the literature in terms of preparation and potential applications. The second type is cotton knitted fabric with ethylcellulose microcapsules containing chitosan nanoparticles with extract immobilized using chitosan glue (GBE is protected by two polymer coatings: chitosan and ethylcellulose). This type of functional knit fabric is a scientific novelty in terms of functional textiles and their applications in various fields of science. Penetration tests (conducted using the Zeta Sizer device and UV-VIS spectrophotometric technique) of nanoparticles with GBE extract and *Ginkgo biloba* extract from microcapsules immobilized into cotton knitted fabrics confirmed the penetration of nanoparticles and the permeation of the extract through a dialysis membrane with a pore size similar to the pore size in the skin in physiological saline environment. This confirms the research thesis of the submitted research work.