

**Abstract for the general public (OPUS):** Electromagnetic field-supported systems for transdermal drug delivery.

### **The project goal, description of research, reasons for attempting a particular research topic**

**Transdermal drug administration** has many advantages and, in many situations, is an advantage over oral or intravenous drug dosing. Among the many advantages of transdermal administration of the drug are the possibility of avoiding the so-called "first-pass effect" (hepatic metabolism) and the elimination of side effects of the drug on the gastrointestinal tract. In addition, this form of drug administration eliminates the potential degradation of the active substance in the gastrointestinal tract. It excludes the possibility of interaction of the drug substance with food and other orally administered drugs. The use of this route of administration (transdermal) allows one to obtain the desired therapeutic effect after the absorption of lower doses of drugs. With the use of an appropriate modification of the therapeutic, allowing for increased permeability through biological membranes, as assumed in the project, these doses can be significantly reduced. In this case, the rate of absorption of the drug substance depends on the rate of its release, while this property, depending on the desired effect, can be properly controlled. In addition, transdermal delivery reduces the frequency of application of drugs with a short biological half-life, which is particularly important in the treatment of chronic diseases. However, it should be remembered that the skin is a natural protective barrier to the body. For this reason, the transport of compounds through the skin is sometimes difficult.

Due to the numerous advantages of the transdermal administration of drugs and the problems associated with this transport (in particular, limited transport of drugs through the skin), **as part of the project, it was decided to develop transdermal drug delivery systems supported by an electromagnetic field.** So far, the mechanisms of increasing the permeability of substances exposed to the electromagnetic field have not been explained. Thus, the correlations between the structure of the active compound, the type of formulation used, and the type of electromagnetic field have not been developed. **The primary goal of the project is to determine the impact of the presence of an electromagnetic field on the phenomenon of transport of pharmaceutically active ingredients through various barriers that allow predicting the transport of the drug through barriers, including natural and artificial membranes.**

The following research hypotheses were formulated in the research project:

- 1. The electromagnetic field (EMF) increases the permeability of active substances through the skin.**
- 2. It is possible to develop transdermal patches based on bacterial cellulose assisted by EMF enabling controlled drug delivery.**

The above hypotheses will be verified through the implementation of the following specific objectives:

1. Research on the impact of various electromagnetic fields (EMF) on natural barriers (skin) and artificial barriers (imitating skin), as well as on the transport of active substances through these barriers.
2. Study of the influence of the type of substrate (different forms of the drug in semi-solid and solid form) on permeability in the presence of EMF.
3. Preparation of drug-modified bacterial cellulose membranes as new drug delivery systems.
4. Determination of how the modification of the compound, the nature of the medium and the chemical modification of bacterial cellulose affect its permeability.
5. Study of the mechanism of drug penetration in the presence of EMF.

The project will determine the relationships between the structure and properties of the active substance, the type and properties of the carrier and the influence of the type of EMF on the permeability of the compound. In particular, the effect of drug-carrier binding on the phenomenon of permeability in the presence of EMF will be determined. The research will be conducted by introducing structural modifications of the active substance and chemical modification of the drug carrier (the model carrier will be bacterial cellulose). Natural chemical enhancers and different types of topical formulations will also be explored and evaluated. The obtained EMF-assisted transdermal therapeutic systems may be used as universal drug delivery systems in the future, and the correlations obtained during the research may contribute to the development of a new method of transdermal drug administration.

### **Substantial results expected**

The correlations between the structure of the active compound, the type of formulation used, and the type of EMF, which are the subject of analysis in this project in the context of the permeability of the active compound, are unknown. The result of the project will be the determination of certain relationships that will allow the development of systems with increased transport through membranes. The results obtained in this project may also contribute to the development of new electromagnetic field-assisted drug delivery systems.