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The use of relaxometry in the study of dosage forms of drugs

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The use of relaxometry opens up new opportunities for the pharmaceutical sciences, especially in the case of research on dosage forms.

The possibility of using NMR relaxometry to analyse interactions between excipients and the active pharmaceutical ingredient (API) in tablets seems to be particularly interesting. In order to make a tablet, it is necessary to use excipients that have no declared pharmacological activity. However, these components affect the API, thus determining two key parameters: pharmacokinetic properties of drugs and durability of dosage forms. These interactions depend not only on the quantity and quality of the ingredients but also on the production parameters, inter alia, compression strength of tablets. Analysis of the interaction between excipients and API using molecular dynamics methods can help simulate and optimize the properties of tablets.

Equally interesting is the use of NMR relaxometry to identify counterfeit drugs. Preliminary studies [1] indicate very high sensitivity and specificity of this method. Due to the fact that in the case of fake drugs chemical analogues of the API are often used, the use of classical methods of chemical analysis such as mass spectroscopy does not allow for identification of counterfeit drugs. The possibility of using molecular dynamics parameters as a fingerprint in relation to the API and excipients in counterfeit and poor-quality medicines in order to "trace" the origin of the ingredients is also intriguing.

NMR relaxometry could also be used for the analysis of molecular dynamics and interactions between the components of topical dosage forms (ointments, creams, etc.). In this case, the key pharmacokinetic parameter is the so-called pharmaceutical availability, which determines the release of the API from the dosage form. When designing a dosage form such as ointment, a compromise should be taken into consideration: the greater the affinity of the active ingredient to the substrate, the more stable the drug will be, but the pharmaceutical availability will be lower. The use of NMR relaxometry can help to optimize the composition of topical drugs, taking into account the interactions between the substrate and the active ingredient.

Moreover, it seems important to use NMR relaxometry to analyse drugs in an amorphous form. The amorphous form of the drug compared to the crystalline form is characterized by generally higher bioavailability. This makes it possible to use lower doses of the drug, which is advantageous from the point of view of economics and health. Analysis of molecular dynamics of amorphous dosage forms may allow for optimization of conditions of manufacture of the amorphous solid dosage forms.

NMR relaxometry can also be used for testing advanced dosage forms, inter alia, those containing liposomes. The drug/liposome (liposome membrane) interaction determines the drug durability (tightness) and pharmacokinetic parameters.

To sum up, NMR relaxometry as a relatively new method has great potential for the pharmaceutical sciences, in particular for the analysis of dosage forms (as indicated) as well as for the analysis of drug/receptor interaction (which has not been discussed).

[1] Wilczyński S, Petelenz M, Florek-Wojciechowska M, Kulesza S, Brym S, Błońska-Fajfrowska B, Kruk D. Verification of the authenticity of drugs by means of NMR relaxometry-Viagra® as an example. J Pharm Biomed Anal. 2017;135:199-205.