Medicines and treatments are essential for keeping us healthy, and medicinal chemistry plays a vital role in developing new ones. However, creating active compounds for drugs can be a challenge. Traditional methods can be costly and time-consuming, which slows down progress in finding new treatments. Developing sustainable and eco-friendly synthetic techniques is essential to protect our planet and health, especially during the pandemic, for example, COVID-19. Chemical synthesis usually requires laborious optimisation of the reaction conditions by trial and error. Therefore, learning about the mechanisms of reactions tracked in real-time significantly impacts the effectiveness of a given process and the possibility of its development and use. There are many tools for monitoring the course of the reaction, among them, a valuable technique is ATR/FTIR spectroscopy using mid-infrared energy. This groundbreaking research project aims to revolutionise the development of new drugs and treatments.

The proposed research will utilise a cutting-edge laboratory system consisting of a multifunctional reactor with the ability to influence chemical synthesis with microwaves, ultrasound and ultraviolet, making it a versatile tool in the synthesis process, and an ATR/FTIR spectrometer, equipped with a fiber optic probe, which will be used to monitor the course of the reaction and analyse the obtained products, making it a noninvasive and efficient tool for analysis. The combination of these techniques has yet to be presented in the literature. This system will monitor chemical reactions in real time, allowing for the optimisation of reaction conditions and the analysis of obtained products.

This unique approach integrates synthetic and analytical tools into a single, comprehensive research system, which has the potential to advance the development of new small-molecule drugs significantly. The reactions we have chosen for analysis are Nitrogen-heterocycles – well known therapeutic agents in various medicinal fields. The realtime non-invasive imaging of the reaction mixture allows for optimising reaction conditions, resulting in reduced reaction times and minimised waste in drug production. This technique can also lead to a deeper understanding of reaction mechanisms, allowing for more sustainable and environmentally friendly methods for synthesising active compounds.

Overall, this research has the potential to significantly contribute to the field of green chemistry and promote more sustainable and pro-ecological approaches to drug development. The originality and innovation of this proposed research are highlighted by the need for prior literature on this specific topic, as it represents an original and innovative approach to the field. This project has the potential to revolutionise the field of medicinal chemistry and significantly contribute to the optimisation of reaction conditions and the development of new small-molecule drugs.