Tutor's statement to the doctoral thesis of Tutut Ummul Habibah on the topic "Development and Evaluation of a Multi-Modal Hyaluronic Acid Hydrogel for Anti-Inflammatory Drug Delivery for MultipleSclerosis Therapy"

Tutut Ummul Habibah did her doctoral project in Contipro a.s. in scope of her distance doctoral study at TBU. In that company she worked under a local supervision of PharmDr. Martin Pravda, Ph.D. while I participated on the supervision by regular discussions of the progress of the project. Tutut's stay in Contipro a.s. was supported by the Marie Sklodowska-Curie fellowship but, unfortunately, started during the time of Covid-19 pandemics which caused the necessity to postpone the beginning of the stay by a few months.

In spite of that, Tutut carried out a serious and compact experimental study concerned with the development of two drug-delivery systems (DDS) aimed at the therapy of multiple sclerosis (MS). Both the systems are based on hydrogel constituted by hyaluronic acid and administered to the patients by injection in the liquid, non-crosslinked state, while the crosslinking process takes place directly in the patients' body. Each of the DDSs contains different drug, minocycline in one case and FITC-modified synthetic Preimplementation factor (FITC-SPIF) in the other case. The hydrogels contain polyelectrolyte complexes that moderate the kinetics of the drug release.

It should be stressed that this work required a manifold of experiments form different fields of science comprising the selection of suitable drugs, design of the synthesis of the hydrogel, optimizing its mechanical and rheological properties, tuning the release kinetics, performing the in vitro measurements of the anti-inflammation activity of the released medium on cell cultures and preparing the material for in vivo testing on experimental animals (at partner's institution). Tutut coped with this amount of work very well and achieved the design of both the DDSs in all the necessary parameters. Hence, not only that Tutut learned a lot of experimental methods and scientific strategies, her work also brought results with a strong application potential and the designed DDSs have a good chance to become real human medicine.

Tutut's work was published in two scientific papers in Carbohydrate Polymers (IF 12.5) and Carbohydrate Polymer Technologies and Applications (IF 6.5), in both cases with her first authorship. During her doctoral studies, Tutut completed an internship at the Institute of Neuropathology, Universitätsklinikum Münster, Germany. Besides it, she participated in several workshops and conferences and fulfilled all the necessities required for completion of the doctoral studies.

In summary, I consider Tutut's work as excellent, I am therefore pleased to recommend the Ph.D. thesis to the defense and to award Tutut the Ph.D. degree.

In Zlín, June 25, 2025

doc. RNDr. Marek Ingr, Ph.D.