Sabbatical Report

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Duration: 19.08.2024 - 23.09.2024
Location: Twente University, Enschede, Netherlands

Introduction:
The purpose of this sabbatical was to gain hands-on experience in biological aspects relevant to my PhD project, specifically focusing on 3D cell culture, organoids, and spheroids. As an engineer with limited biological experience, I aimed to immerse myself in practical laboratory work to develop the skills needed for my research on glioma-on-chip. This report outlines my activities, achievements, challenges, and reflections during my time at Twente University, Netherlands.

Summary of Activities:
During my sabbatical, I engaged in activities aimed at enhancing my understanding of biological cell culture techniques, particularly in the context of glioma-on-chip research. I took part in practical work at Prof. Jai Prakash's lab at Twente University, where I focused on learning about 3D cell culture, organoids, and spheroids. Although Prof. Prakash's previous glioma-on-chip projects had concluded, I had the opportunity to work on breast cancer cell culture projects, which provided valuable insights into related techniques.

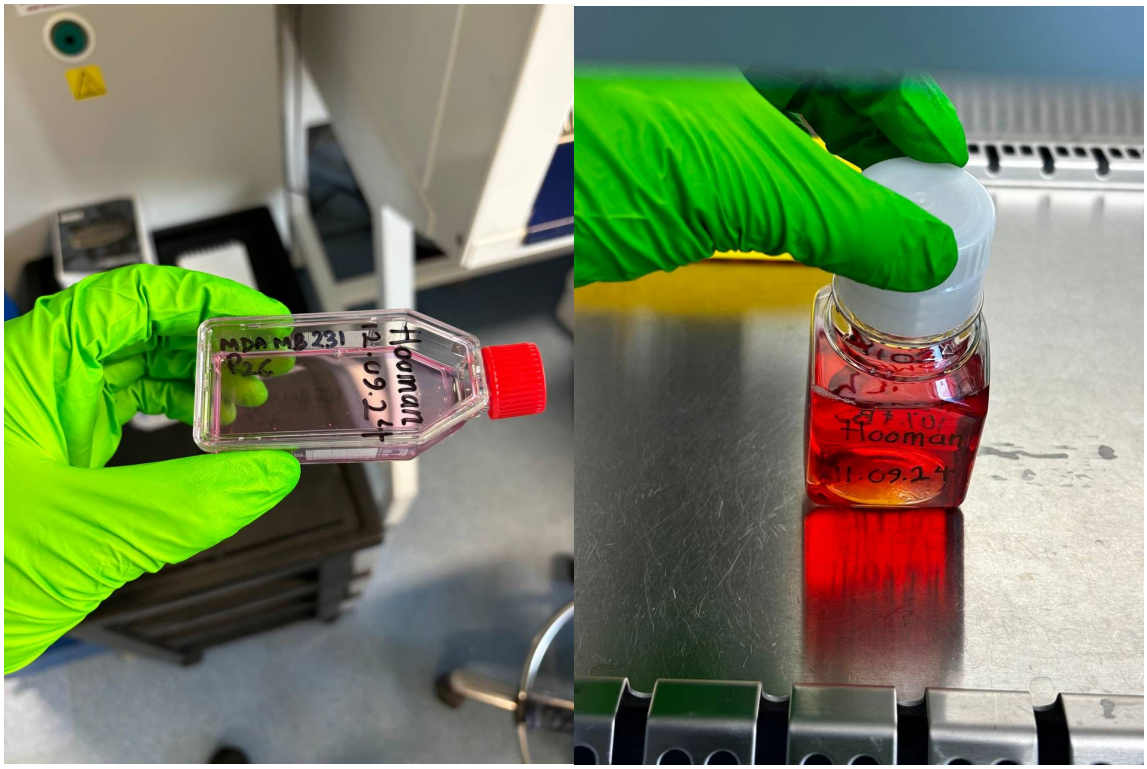

Figure 1) My first-ever media preparation for cell culture and cell lines cultured during my sabbatical.

Achievements:
Research and Learning: I conducted hands-on research on 2D and 3D cell culture techniques, including cell handling, scaffolding, and spheroid formation. This experience significantly broadened my understanding of cell culture and imaging, which is crucial for my ongoing PhD project on glioma-on-chip.

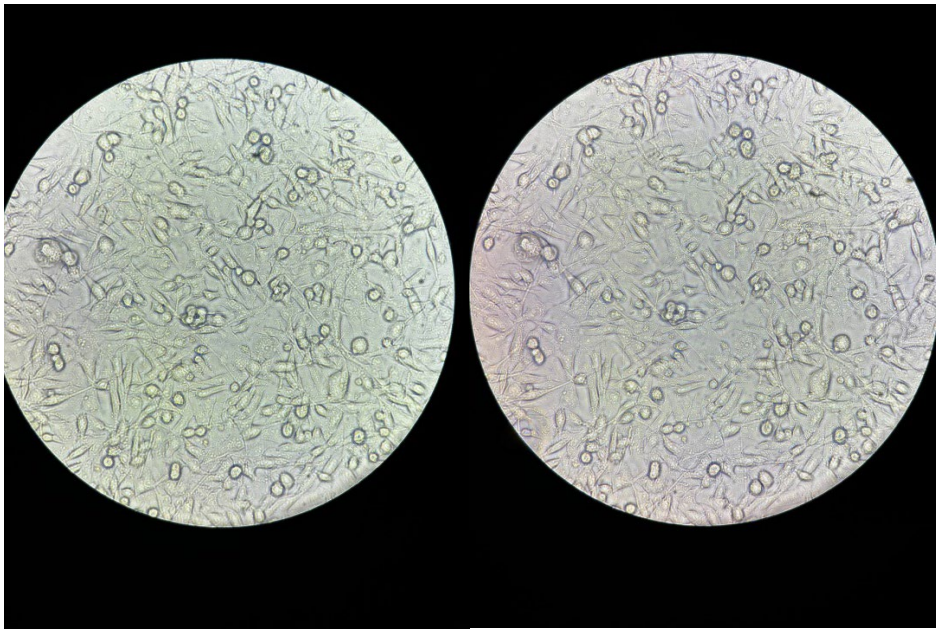

Figure 2) Breast cancer cells under the microscope before reaching confluency.

Skill Development: I learned essential skills in cell handling, scaffolding, spheroid formation, and microscope-based cell observation. These skills are directly applicable to my PhD work, where I aim to develop a glioblastoma-on-chip platform. The experience has also improved my confidence in handling biological materials, an area I had limited exposure to as an engineer.

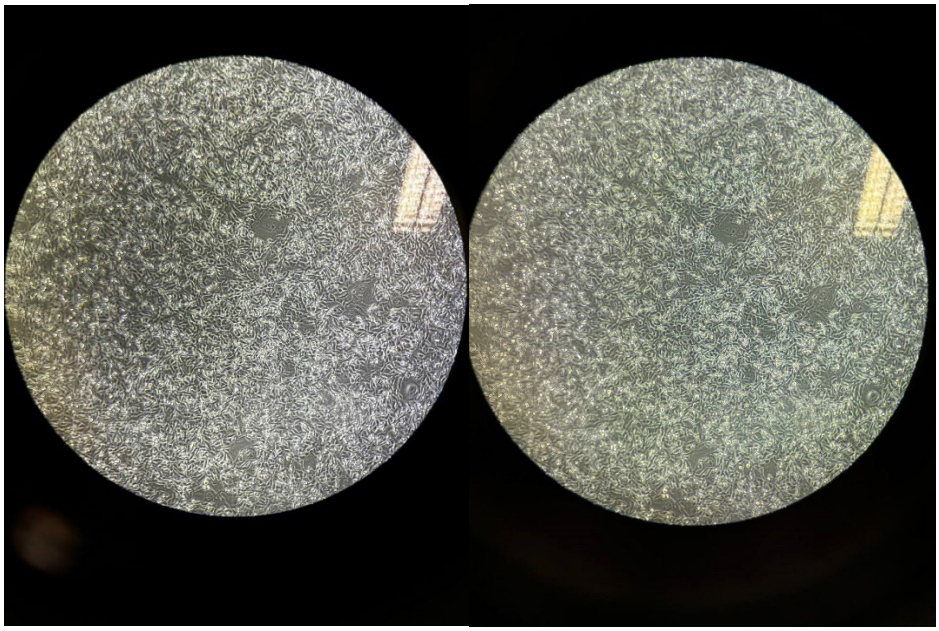

Figure 3) Breast cancer cells under the microscope reaching full confluency.

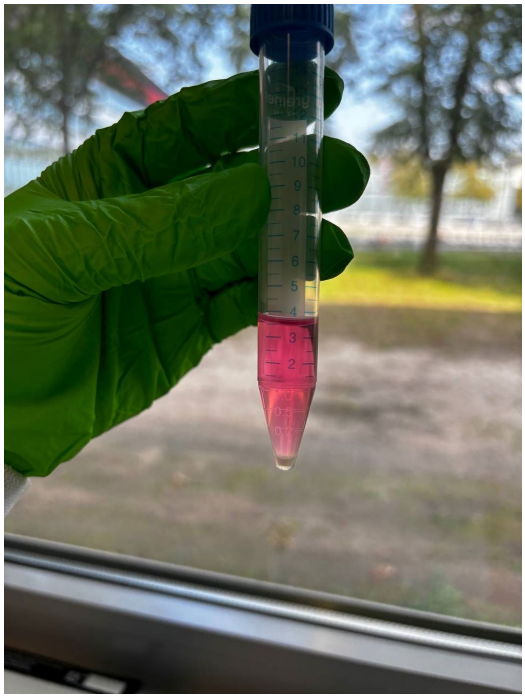

Figure 4) Breast cancer cells after reaching confluency and spinning in the centrifuge machine, during the second passage.

Networking and Collaboration: I had the opportunity to work alongside experienced researchers in Prof. Prakash's lab, which helped me expand my professional network in the field of biomedical engineering and cell biology. I also had the privilege of working closely with Dr. Nupur, a biologist in Prof. Prakash's team, who provided significant guidance and support during my learning process. Her expertise in cell culture was instrumental in helping me navigate the challenges I faced as an engineer without a biological background.

Figure 5) Dr. Nupur Mukherjee, who helped me significantly during my sabbatical.

Additionally, I established effective connections with several key researchers working on advanced organ-on-chip technologies and related fields:

1. Prof. Dr. Andries van der Meer: The scientific lead at OoCCT, Prof. van der Meer focuses on developing microfluidic organ-on-chip systems to model human tissues, particularly in vascular biology and thrombosis. His work integrates stem cell technology with organ-on-chip platforms to improve drug testing and disease modeling. We discussed the potential of integrating my research with their vascular biology models.

2. Dr. Liliana Moreira Teixeira: Co-founder of OoCCT and a board member of the European Organ-on-Chip Society, Dr. Teixeira is working on advanced modular organ-on-chip systems for personalized medicine and tissue engineering. Her research spans various applications, including precision medicine and biomimetic platforms for drug discovery. I had the opportunity to discuss the E-cost project with her, and we explored possibilities for collaboration in future research initiatives.

3. Prof. Marcel Karperien: From the Developmental BioEngineering group, Prof. Karperien is developing a "joint-on-a-chip" to study osteoarthrosis, which could lead to breakthroughs in treating joint diseases that currently lack effective therapies. Our conversations included discussing the potential applications of my work on glioma-on-chip alongside his joint-on-chip research, highlighting areas for interdisciplinary collaboration.

Reflections and Outcomes:
The sabbatical provided me with an invaluable opportunity to step outside my comfort zone and immerse myself in the biological aspects of my research. This experience has enhanced my understanding of cell culture techniques and given me new perspectives on integrating biology with engineering for my glioma-on-chip project. I plan to apply these newly acquired skills in my research and further explore the integration of microfluidics and 3D cell culture in my PhD work.

Challenges and Solutions:
One of the main challenges I faced during my sabbatical was handling cells and understanding the underlying theories of cell culture, given my background as a mechanical engineer with no prior experience in biology. Additionally, another main challenge was the fact that there were no ongoing projects on organ-on-chips or glioblastoma when I was there. As a result, I had to learn the fundamentals of cell culture by working on breast cancer cells. To overcome these challenges, I actively sought guidance from lab members and invested time in reading foundational literature on cell culture and imaging techniques. This approach not only helped me overcome my initial difficulties but also strengthened my problem-solving abilities and adaptability in a new research environment.

Conclusion:
Overall, my sabbatical at Twente University was an enriching experience that provided significant opportunities for skill development and professional growth. I am grateful for the opportunity to learn from experts in the field and gain practical experience that will be instrumental in advancing my PhD research. I am excited to bring my new insights and skills back to my work at Teesside University.

Moving forward, I plan to integrate the cell culture techniques I learned into my glioma-on-chip project. I will also share my findings and experiences with my supervisors and colleagues to enhance our collective understanding of 3D cell culture applications. I believe that the experiences gained during this sabbatical will contribute positively to both my personal growth and the progress of my PhD research.

Figure 6) Celebration of Success: I successfully performed my first passage of cells, which was a significant milestone for me, especially given my limited biological background.

Acknowledgment of Funding:
I would like to express my sincere gratitude to the Management Committee of the COST Action CA22103 for their generous support in funding my Short Term Scientific Mission (STSM). This funding, under the reference E-COST-GRANT-CA22103-84916e1e, made it possible for me to engage in hands-on research on the development of a cancer-on-chip preclinical model for glioblastoma at Twente University. The grant of EUR 3,800.00 enabled me to immerse myself in learning key biological techniques, which will significantly benefit my ongoing PhD research. I am deeply thankful for their contribution, which has played a crucial role in my professional development.