NTU-KU Joint Funding

Final Report

Section 1

NTU principle investigator	
Name (last name, first name)	Hou, Yung-Te
Position	Associate professor
Faculty/Department	Department of Biomechatronics Engineering

KU principle investigator	
Name (last name, first name)	Kamei, Ken-ichiro
Position	Associate professor
Faculty/Department	WPI-iCeMS
Visiting ECR1	
Name (last name, first name)	Huang, Wan-Ting
Position	Master student
Faculty/Department	Department of Biomechatronics Engineering

*Please complete this section if the KU principal investigators hosted ECRs from NTU.

Visiting ECR2	
Name (last name, first name)	Yin, Wei-Rong
Position	Master student
Faculty/Department	Department of Biomechatronics Engineering

*Please complete this section if the KU principal investigators hosted ECRs from NTU.

Host researcher*	
Name (last name, first name)	
Position	
Faculty/Department	

*Please complete this section if the host researcher is different from the KU principal investigator.

Section 2

Project title	
	A 3D cultured liver-on-a-chip platform for hepatocurative and hepatoprotective evaluation of tannic acid

Section 3

Period of project	
From dd/mm/yy to dd/mm/yy	**ECR1: From 13/06/2022 to 29/07/2022** **ECR2: From 03/10/2022 to 16/11/2022**

Section 4

Summary of the project (approx. 100 words)
*KU PIs are required to submit a summary of the project in Japanese in addition to the English summary (approx. 200–300 characters).

(Please enter the summary of the project)

The objective of this project is to develop a liver-on-a-chip (LOC) platform for efficient screening of hepatoprotective and hepatic therapeutic agents such as tannic acid (TA). Additionally, the project aims to establish in vitro liver disease models to facilitate drug development. The micro-system will mimic the liver microenvironment by co-culturing hepatocytes and HUVEC on a microfluidic device.

During the NTU-KU joint program, collaborative efforts between the Hou's lab and Professor Kamei's lab were directed towards developing the microfluidic system and refining the liver microenvironment. Through our observations, we discovered a synergistic effect when co-culturing the HepG2 and HUVECs within the double-layer channel system. Additionally, we identified the importance of testing different concentrations of toxic substances and devising measures to prevent their dilution within the device material while establishing a liver damage model. These aspects will be further investigated in forthcoming studies. Unfortunately, the Covid-19 pandemic prevented us from extending an invitation to Professor Kamei to visit Taiwan, which was a regrettable outcome. Nevertheless, we remain committed to ongoing communication and collaboration, with the aim of mutually benefiting from our partnership in the future.

Finally, we believe this project aligns with the program's emphasis on fostering collaboration between Taiwan and Japan in liver-related research, and holds substantial potential for significant advancements in public health in both countries.

本プロジェクトは、効率的な肝保護・肝治療剤スクリーニングのためのLiver-on-a-Chip （LOC）プラットフォーム開発と*in vitro*肝疾患モデル確立を目指す。侯研究室と亀井研究室が、マイクロ流体システム開発と肝臓微小環境改善に協力し、HepG2とHUVECの共培養による相乗効果と有害物質濃度調整の重要性を確認した。COVID-19影響で亀井がNTUを訪問することは実現していないが、コラボレーションを継続し、相互利益を目指す。プロジェクトは両国の研究協力促進・公衆衛生向上への寄与が期待される。

Section 5 (Please complete this section if ECRs from NTU participated in collaborative research at KU)

Achievements and Outcomes of ECRs' Stay (approx. 100–250 words)

*This section should be filled by each of the ECR(s) (one paragraph per ECR) based on his/her experience of staying in Japan.

(Please enter the achievements and outcomes for each of the ECR(s).)

ECR1:

During my two-month stay in Japan last June and July, I had the privilege of learning from esteemed researchers and mentors in the fields of microfluidics and cell culture. This experience greatly enhanced my knowledge and skills in culturing HepG2 and HUVEC in microfluidic co-culture systems, deepening my understanding of cell-microenvironment interactions. Additionally, I improved my language proficiency and gained insights into Japanese culture through immersion, attending workshops, conferences, and networking events alongside diverse researchers from different backgrounds. These experiences fostered international collaborations and broadened my horizons, contributing to my future research and career prospects.

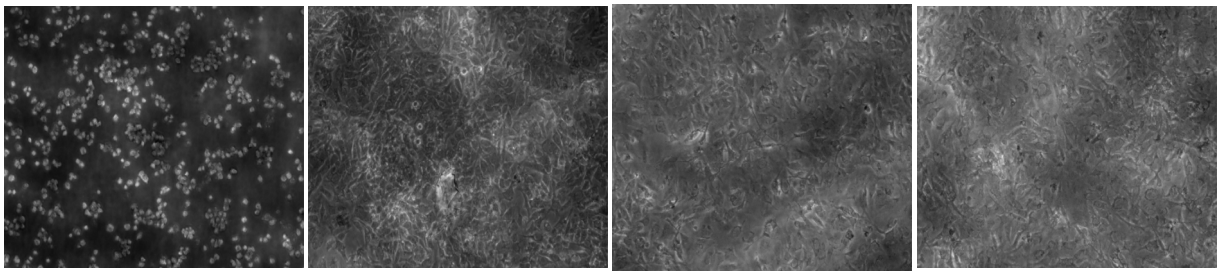
ECR2:

In this NTU-KU joint program, I have had the privilege to study in the Professor Kamei's Lab. Throughout the learning process, I have acquired skills in fabricating a double-layer microfluidic system and utilizing it for cell culture experiments. In order to mimic the liver microenvironment, we opted to culture the HepG2 along with HUVECs. The HepG2 serve as a liver mimic, while the HUVECs act as a barrier, resembling the surface of blood vessels. This configuration enables us to investigate the drug penetration into the liver. Although this study represents a preliminary investigation, future research aims to employ primary hepatocytes and sinusoidal endothelial cells in a co-culture system, aiming for a more accurate representation of the liver's cellular composition. I have achieved successful cell culture on the microfluidic system, resulting in high cell viability. Additionally, cytotoxicity tests were conducted using immunofluorescent staining, and cell viability was assessed to evaluate the system's performance.

Section 6

Photographs with captions
*Please submit digital files (such as JPEG or GIF files) of the photographs used in your report as attachments. The size of each image should be at least 4MB, so that it can be used for printed materials. Please ensure that none of the photographs submitted will cause any issues relating to portrait rights.
URL at which project outcomes can be viewed (Optional)
*E.g. workshop notifications/programs/reports, evidence of academic papers published or otherwise made available, etc.
URL:

ECR1:



Day 0 Day 1 Day 3 Day 5

Fig. 1: Observation of HepG2 morphologies within the flow channel using microscopy.

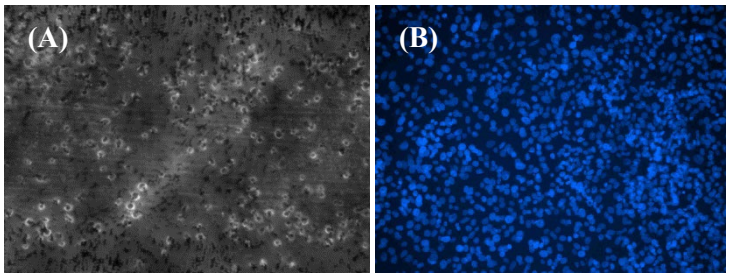


Fig. 2: (A) Observation of HUVEC morphologies within the flow channel using microscopy (B) Observation of HepG2 morphologies within the flow channel using flurescence microscope, specifically through DAPI staining.

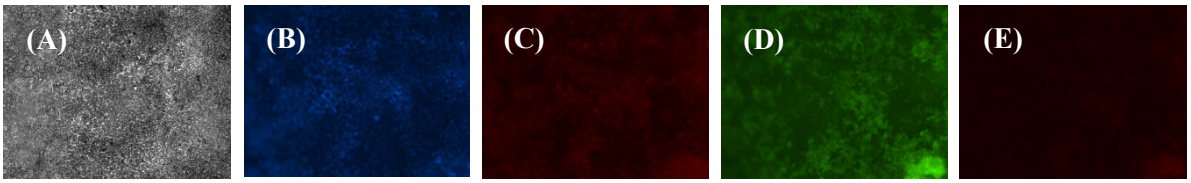


Fig. 3: Immunostaining-HepG2 poison after CCl_4 (A) Microscopy images (B) DAPI staining (C) ZO-1 statining (D) TNF- α staining (E) iNOs staining.

Fig. 4: (A) Prof. Kamei’s Lab. (B) The experimental environment in Prof. Kamei's lab.
(C) Welcome party.