ENGINEERING OF ASSEMBLOID CULTURE FOR AN INTEGRATED 3D TISSUE FORMATION

2025-PARK-71242

PROBLEM

Conventional methods for forming assembloids rely on passive aggregation strategies such as putting organoids in proximity to allow for fusion. This leads to limited spatial control over the fusion process and difficulty with regulation of the microenvironment. Additionally, passive aggregation strategies suffer from issues with reproducibility and scalability, as well as lacking in control over the soluble biochemical environment.

SOLUTION

Researchers at Purdue University have designed a microfluidic platform that addresses the prior concerns and allows for assembly and maintenance of 3D assembloids and control over the soluble microenvironment.

VALIDATION

- Tested system using mouse and human intestinal organoids as proof-of-concept
- Showed reproducibility of system and signaling responses were spatially localized confirming controlled compartmentalization within larger construct

ADVANTAGES

- Can support formation and maintenance of 3D assembloids
- Reproducible system
- Control over soluble biochemical environment and spatial control of microenvironment

APPLICATIONS

- Controlled construction of complex tissue models in vitro
- Disease modeling and drug screening in vitro

INTELLECTUAL PROPERTY STATUS

Provisional Patent U.S.

For more information on developing or commercializing this technology, contact:

Joy Wu | *Licensing Associate – Life Sciences*
jwu@prf.org

PURDUE INNOVATES

RAPID-FORMING 3D INTESTINAL CRYPT-VILLUS HYDROGEL PLATFORM FOR DRUG AND DISEASE MODELING

2025-LIN-71031

PROBLEM

Pharmaceutical and biotech researchers face major limitations when using flat trans-well membranes, which fail to replicate the 3D crypt-villus topology that governs intestinal absorption, barrier function, and disease progression.

SOLUTION

This technology introduces a new class of bioactive hydrogel scaffolds that incorporate physiologically relevant architectural and biochemical cues to support extremely rapid formation of functional intestinal epithelium. Unlike typical systems requiring weeks of culture and producing non-physiological transport behavior, this platform demonstrates fast epithelial coverage and selective barrier performance consistent with native intestine.

VALIDATION

Validation was conducted using benchtop epithelialization studies and barrier assays demonstrating formation of functional monolayers and selective transport behavior. Additional studies confirmed barrier response to toxic challenges and performance differences across regions mimicking healthy and disease-like morphologies.

ADVANTAGES

- Rapid formation of biomimetic intestinal epithelium compared to conventional inserts
- More physiologically relevant 3D structure for absorption and barrier assessment
- Compatible with common intestinal cell lines and streamlined for industry workflows
- Improved predictive value for drug transport and toxicity screening
- Supports integrated modeling of healthy and disease-like intestinal states

APPLICATIONS

- Preclinical drug absorption and permeability testing
- Gastrointestinal toxicity screening
- In vitro disease modeling including villus-atrophy conditions
- Bioprinting-enabled development of advanced intestinal models
- High-throughput screening requiring rapid epithelial formation

INTELLECTUAL PROPERTY STATUS

Provisional-Gov. Funding, U.S.

For more information on developing or commercializing this technology, contact:

Joy Wu | *Licensing Associate – Life Sciences*
jwu@prf.org

PURDUE INNOVATES

HUMAN BRAIN IN VITRO MODEL FOR DRUG SCREENING AND DISEASE MODELING

2026-KNIP-71289

PROBLEM

Pharmaceutical and biotech R&D teams face persistent bottlenecks in CNS drug development due to unreliable predictions of blood-brain barrier (BBB) permeability and neurotoxicity, resulting in high attrition rates and costly late-stage failures. Existing in vitro models, such as organoids and indirect BBB systems, often lack the physiological relevance and functional separation needed for accurate screening, while animal models are expensive and poorly predictive.

SOLUTION

This technology introduces a direct contact triculture human brain model that uniquely layers astrocytes, pericytes, and brain microvessel endothelial cells with brain parenchymal cells in a Transwell system, enabling distinct assessment of BBB integrity and neuronal or inflammatory responses.

TECHNOLOGY VALIDATION

- Lab-validated with reproducible results using standard cell lines and Transwell systems.
- Demonstrated lower permeability coefficients (e.g., Peff for 4kD dextran: 3.7 x 10^-6 cm/sec) versus monoculture/coculture models.
- Functional activity of key efflux transporters (P-gp, BCRP) confirmed.

ADVANTAGES

- Closely mimics human neurovascular unit for superior physiological relevance.
- Distinct separation of BBB and neuronal/inflammatory responses for targeted screening.
- Compatible with existing lab equipment and scalable for moderate-throughput studies.
- Reduces reliance on animal models, supporting cost and ethical goals.

APPLICATIONS

- CNS drug permeability and neurotoxicity screening by pharma and biotech R&D.
- Disease modeling for neurodegenerative and neurodevelopmental disorders.
- Phenotypic screening and validation of neurotherapeutics.
- Integration into CRO and academic research platforms for preclinical studies.
- Toxicology and excipient assessment for drug delivery R&D.

INTELLECTUAL PROPERTY STATUS

Provisional-Gov. Funding, U.S.

For more information on developing or commercializing this technology, contact:

Joy Wu | *Licensing Associate – Life Sciences*
jwu@prf.org

PURDUE INNOVATES

A LAB-ON-CHIP ULTRASONIC PLATFORM FOR REAL-TIME AND NONDESTRUCTIVE ASSESSMENT OF EXTRACELLULAR MATRIX STIFFNESS

2020-RAHI-68964

PROBLEM

Current technologies used to measure ECM stiffness in vitro are often invasive and expensive as well as sometimes limited to detecting cell destruction only after detrimental cell deformations have already occurred.

SOLUTION

Researchers at Purdue University have developed a method of in vitro measurement of extracellular matrix (ECM) stiffness that is nondestructive and provides fast readout. The approach fine-tuned by Purdue researchers includes a noninvasive on-chip platform that can characterize ECM stiffness with up to 93% accuracy.

VALIDATION

The efficiency and long term stability of the ultrasonic stiffness measurement method was validated in various hydrogels with different stiffness levels. Additionally, in vitro cell culture tests showed a reasonable cell viability and survival rate under continuous exposure to an ultrasonic wave inside the platform.

ADVANTAGES

- Low cost
- Nondestructive
- Accurate

APPLICATIONS

- Biomedical
- Research
- 3D Cell Cultures
- Drug Screening
- Therapeutic Efficacy Monitoring

INTELLECTUAL PROPERTY STATUS

Provisional-Gov. Funding, U.S.
Utility-Gov. Funding, U.S.

For more information on developing or commercializing this technology, contact:

Joy Wu | *Licensing Associate – Life Sciences*

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