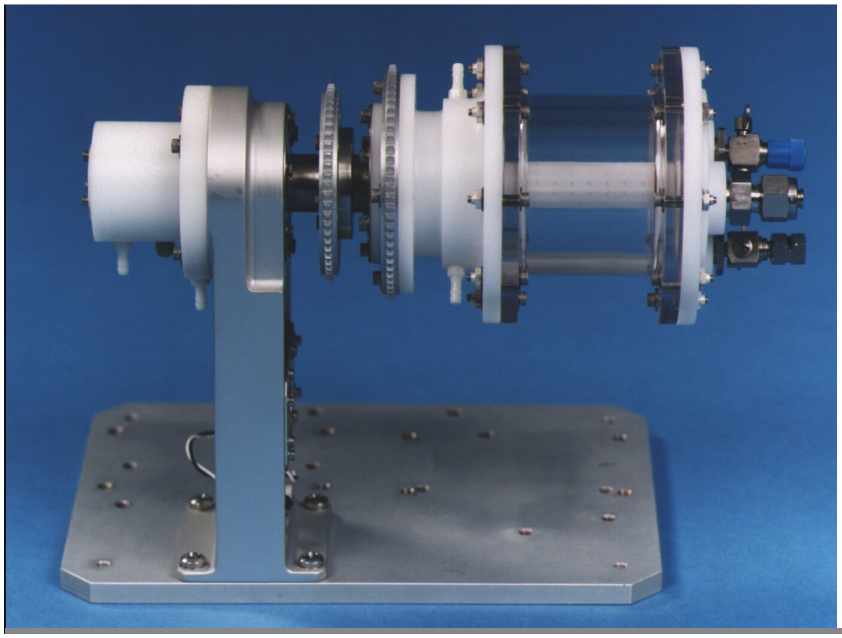


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Health, Medicine and Biotechnology

Human Tissue-Like Cellular Assemblies Grown for Respiratory Studies

New 3D growth method emulates infection dynamics of in vivo microbial invasion

Innovators at NASA Johnson Space Center have developed a technology that yields three-dimensional (3D) tissue-like assemblies (TLAs) of human broncho-epithelial (HBE) cells for in vitro research on infection of humans by respiratory viruses. Compared to traditional two-dimensional (2D) monolayer cell culture, the 3D TLAs more accurately represent the active environment present in respiratory infections. It offers a cost-effective platform that functions like in vivo human tissue, reducing the need for human subject testing and supporting a more controlled testing environment free from immune system limitations. 3D TLAs provide an opportunity to study the tolerance to bioactive ingredients, the impacts of developing vaccinations on respiratory tissues, and other applications directed to product development for the cosmetics and textile industries.

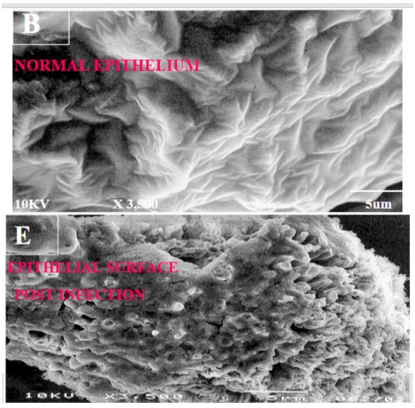
BENEFITS

- Enables unique interactional study of complex respiratory viruses
- Reduces need for human subject testing
- Assists rapid testing by providing cost-effective platform for studying infections and vaccines
- Advances infection dynamics of in vivo microbial adhesion and invasion

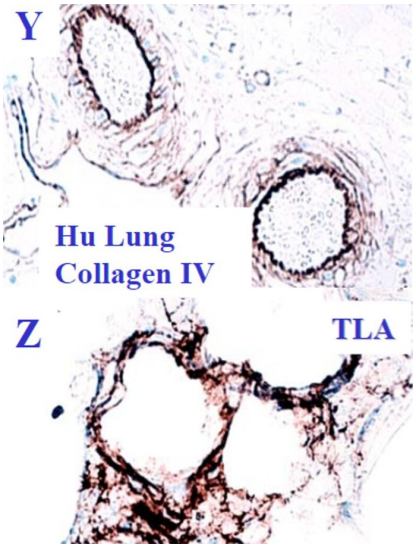
THE TECHNOLOGY

In vitro three-dimensional (3D) human broncho-epithelial (HBE) tissue-like assemblies (3D HBE TLAs or TLAs) were engineered in modeled microgravity using rotating wall vessel technology (pictured above) to mimic the characteristics of in vivo tissue. The TLAs were bioengineered onto collagen-coated cyclodextran beads using primary human mesenchymal bronchial-tracheal cells (HBTC) as the foundation matrix and an adult human broncho-epithelial immortalized cell line (BEAS-2B) as the overlying component. The resulting TLAs share significant characteristics with in vivo human respiratory epithelium including polarization, tight junctions, desmosomes, and microvilli. The presence of tissue-like differentiation markers including villi, keratins, and specific lung epithelium markers, as well as the production of tissue mucin, further confirm these TLAs have differentiated into tissues functionally like in vivo tissues. TLAs mimic aspects of the human respiratory epithelium and provide a unique capability to study the interactions of respiratory viruses and their primary target tissue independent of the host's immune system.

The innovation "Methods For Growing Tissue-Like 3D Assemblies Of Human Broncho-Epithelial Cells" is at Technology Readiness Level (TRL) 6 (which means system/subsystem prototype demonstration in a relevant environment) and the related patent is now available to license for development into a commercial product. Please note that NASA does not manufacture products itself for commercial sale.



Shown: 3D human broncho-epithelial (HBE) tissue-like assembly (TLA) pre-infection (top) as normal epithelium, and post wtRSVA2 viral infection epithelial surface (bottom).



Shown: presence of Collagen IV in normal human lung tissue (top), and Collagen IV comparatively expressed in the tissue-like assemblies (bottom).

APPLICATIONS

The technology has several potential applications:

- Medical: Vaccination studies for respiratory diseases
- Cosmetics: Product development
- Textile: Testing physiological tolerance to substances

PUBLICATIONS

Patent No: 8338114

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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