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Optimisation of surface treatments in cell culture systems for space satellite models

Space research

Astronauts experience loss of muscle and bone mass along with space motion sickness upon returning to earth. This is due to distinctive properties present in space, which are not found on earth, including microgravity and radiation from cosmic rays. Previous biological research on space missions has revealed interesting changes to cellular, animal and human models (Becker and Souza, 2013) . Therefore, such research is considered particularly important to deepen our understanding of biological effects in space. As space research is expensive, due to the cost of travelling on space rockets, smaller satellite models such as the BAMMSat (developed by David Cullen at Cranfield University) are actively being developed to allow more frequent and inexpensive biological experiments in space. This project aims to optimise cell culture in this system to use in the future for space biological research.

Aims

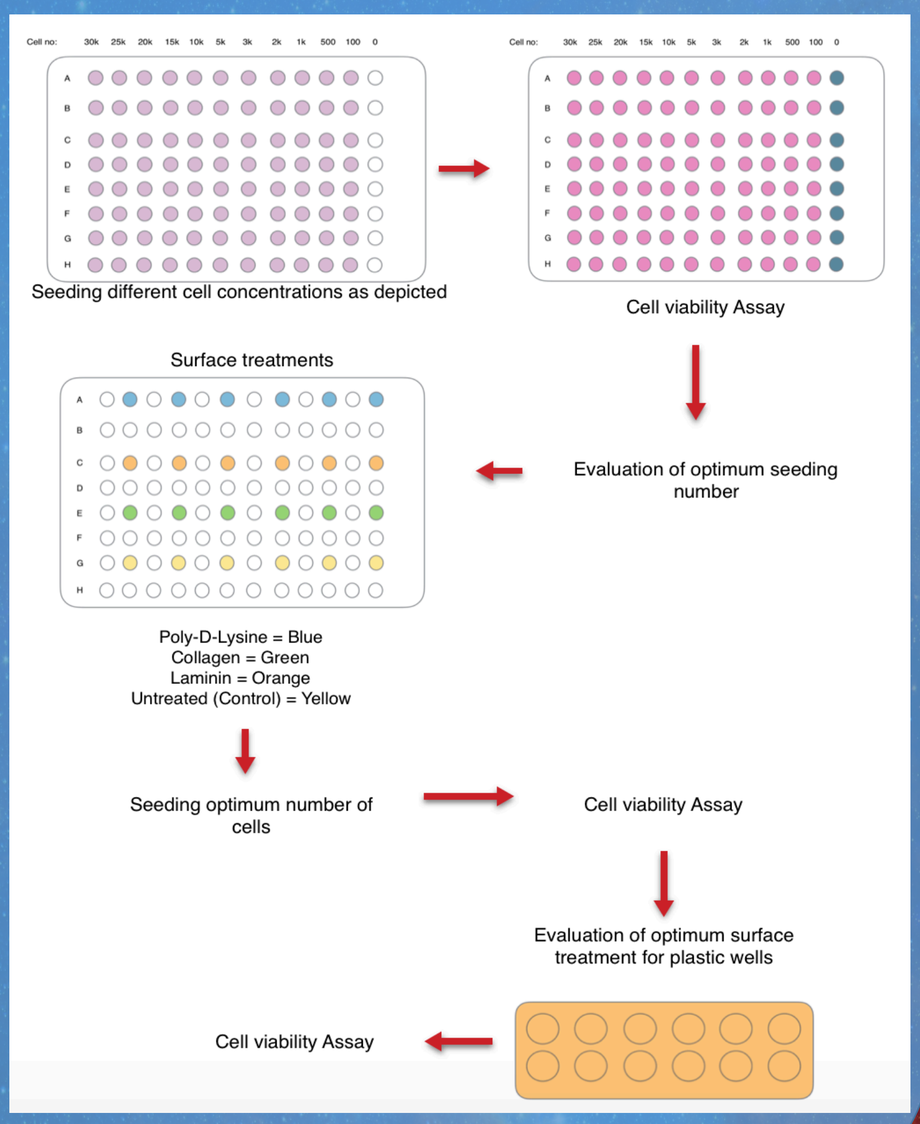
To optimise surface treatments for the promotion of cell viability in HeLa cells grown on polymer wells for space satellite models

Methods

1) Evaluating the most appropriate seeding cell concentration – This allows us to know how many cells to use for growing

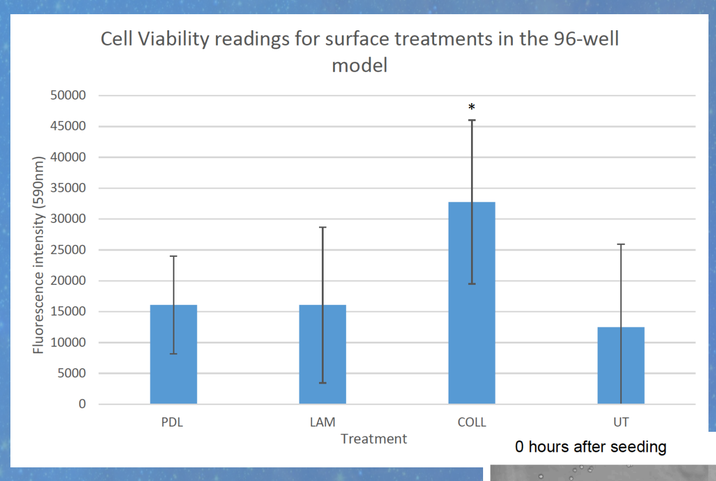
2) Surface treatments in the prototype cell culture wells & seeding cells – This allows narrowing of surface treatment choices for use in plastic wells

3) Surface treatments in plastic wells and seeding of cells – to evaluate most appropriate surface treatment for polymer wells

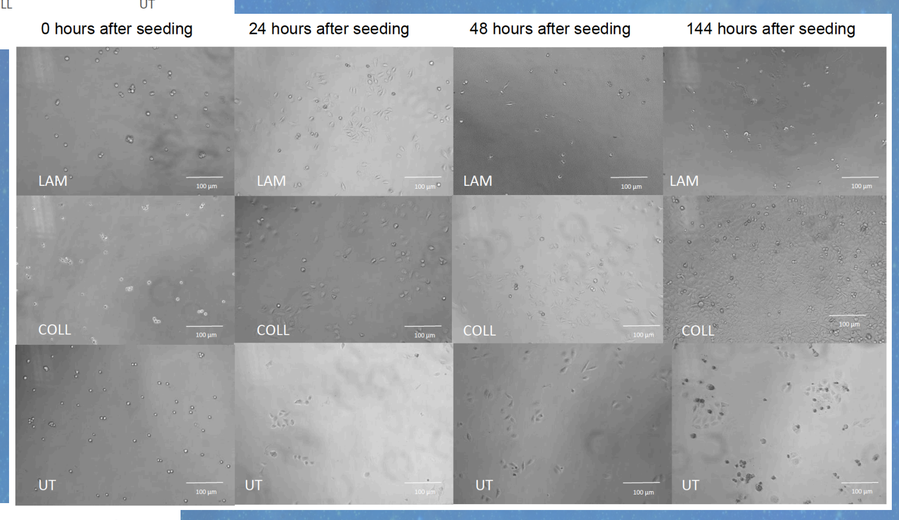


Results

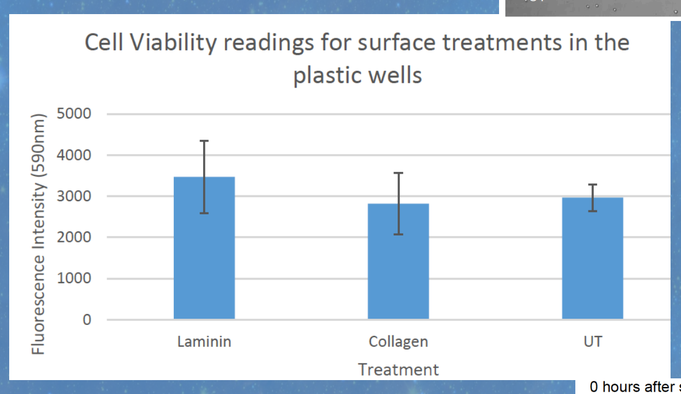
After both the 96-well plate and the plastic wells had 7500 cells/well seeded in, these were grown for a week before assaying for cell health.



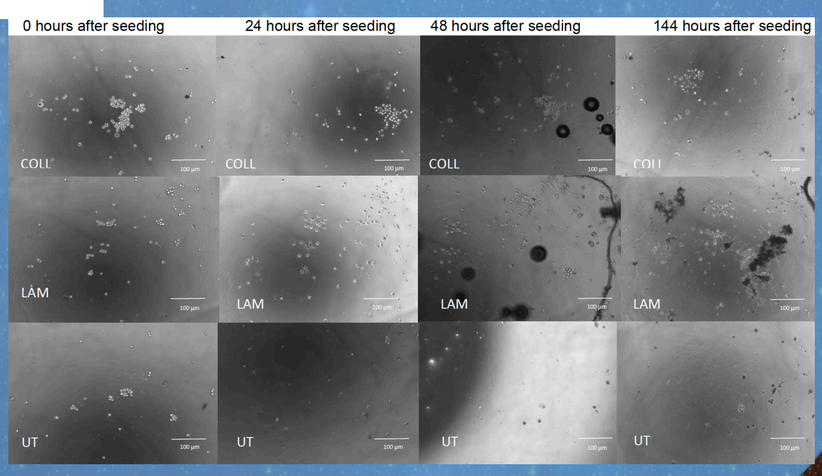
In the prototype 96-well plate, collagen produced the highest cell health amongst all treatments. This was also statistically significant at $p<0.05$.



Cell attachment by morphology and cell health were positively correlated.



Laminin and Collagen treatments did not produce high cell health in the plastic wells.



No cell attachment seen in any plastic wells and morphology observed was poor and apoptosis/necrosis was visible throughout the wells.

Benefits of research and future work

Future work can include: repeats of the experiments, pre-treatment of the plastic wells using oxygen plasma (Jokinen et al., 2012) , binding assays to measure attachment of surface treatment to plastic well (Sharma *et al.* ,2015) , adjustment of plastic well design, designing of a lid or the use of porous membranes.

Wider benefits in research: link between cell viability and surface properties, appropriate treatments to use in cell culturing, appropriate treatments to use for unique cell culturing surfaces, cheaper space satellite model alternative to complex microbeads used

References:

Becker, J. and Souza, G. (2013). Using space-based investigations to inform cancer research on Earth. *Nature Reviews Cancer*, 13(5), pp.315-327.

Jokinen, V., Suvanto, P. and Franssila, S. (2012). Oxygen and nitrogen plasma hydrophilization and hydrophobic recovery of polymers. *Biomicrofluidics*, 6(1), p.016501

Sharma, V., Blackwood, K., Haddow, D., Hook, L., Mason, C., Dye, J. and García-Gareta, E. (2015). Method for estimating protein binding capacity of polymeric systems. *Biochimie Open*, 1, pp.40-50