The importance of mammalian cell culture for medical research

Science, Biology

Cell culturing is possibly the most vastly used technique in laboratories and research centres worldwide. With increasingly accurate environments of simple monocultures or complex polycultures being established, advancements within medical research can be made. Mammalian cell culture is enabling progress in areas such as cancer and vaccinations, allowing for accurate representations of cell interactions and signalling. It is not without problems however, some in the knowledge and understanding of the new techniques developed and others in the ethics of use for different materials. As more precise techniques are discovered, there will be an increase in knowledge of mammalian cell culture which goes hand in hand with medical research, thus, progressing further in more efficient treatments.

Cell culturing dates back to the start of the twentieth century and is now a staple in use for modern research. Although ground-breaking at that time, the cultures were often offset due to contamination. Over time, techniques to minimise contamination have been put in place and have therefore allowed for the production of increasingly accurate in vitro cultures. Further progress by the development of defined culture and the ability to control culture conditions is allowing for a greater depth of medical research to be carried out, leading us towards the end goal of individualised cell-based therapies and completely personalised medicine.

Although cell culture techniques have been used since late 1800 / early 1900s, not many breakthroughs in research were being made, however, this was until the name Mrs Henrietta Lacks came about. HeLa cells as they are now known, were discovered when a biopsy of a cervical tumour was taken

from Mrs Lacks, the cells from which were placed into a petri dish. When the HeLa cells, unlike past cervical cancer specimens, were introduced to the culture medium they proliferated with ease and as a result, became the first human cancer cell line not to enter senescence in culture. HeLa cells have been used for medical research into many areas including; causative and suppressive genes of cancer as well as drug development for haemophilia and Parkinson's Disease to name only a few. An estimated weight of all HeLa cells grown since the discovery in 1950s is 50 million metric tonnes. HeLa cells were also vitally important in the production of Jonas Salks' polio vaccine where the cells were needed in vast amounts in order to test the vaccine, the HeLa cell project was set up to allow this to happen. (202)The use of cell culture methods in vaccine preparation has grown in recent years. In a study by N. R. Hegde it stated that vaccines for the influenza virus produced by growth in cell culture have a greater antigenic and structural similarity to that of the virus, whereas, a vaccine from embryonated chicken eggs is much less similar.

It should also be noted that the vaccine production is much more easily scaled up when carried out by cell culture means, this would be very useful as it allows for efficiency in vaccine turnover to be as high as possible. Cell culturing is therefore allowing for increasingly accurate and efficient medical research and thus, vaccine production to be implemented. Furthermore, cell culture techniques avoid some ethical and moral problems that carrying out animal-based experiments, like using E. C. E, does not. This however does not mean it is without problem, usually collection of Foetal Bovine Serum

used for cell cultures is inhumane, so much so that it could be argued to go against “ The Three R’s Concept” for use of animals in medical research. Therefore, the increase in the use of mammalian cell culture studies should not have an inverse effect on adherence to guidelines for use of animals in lab work such as those outlined by NC3Rs. Microorganisms are one of the greatest enemies to cell culturing, their presence can cause a complete culture batch to be invalidated. With a growth rate of around ten to fifty times faster than the mammalian cell, it is important that proper aseptic technique is maintained throughout the process. Nikfarjam, L. , and Farzaneh, P. , state that bacterial and fungal contaminations are not the organisms that put cultures at greatest risk, it is instead mycoplasma as it is not as easily detected (2011a). Cell culture media and sera themselves are one of the primary sources of contamination by mycoplasma as well as lab personnel themselves.

When the term ‘ Cell Culturing’ is heard, usually a single monolayer growing on a planar surface such as a petri dish is considered. Recently however, efforts have been made to part from this tradition and delve into the 3D cell culturing techniques that go under the radar in comparison. As Edmondson, R. , et al. , (2014) state, 2D cell culturing is falling short as, in vivo, cells are neighboured by other cells and have a surrounding extracellular matrix. Furthermore, they state that 3D culturing has greater accuracy in replicating the microenvironment where the cell itself normally is in tissue and has greater similarity when it comes to structure and cellular response. In this way, 3D cell culturing would be useful for culturing cancer tumour cells and

would allow for more accurate testing when it comes to drug treatments. When it comes to 3D tumour cell culture there are various methods, each with pros and cons for individual areas of study, most of these are monocultures. A 3D cell co-culture method is however being looked into as, in breast cancer for example, there is involvement of more than one type of cell. This leads to an even more complex, almost mirror image of what the environment in the breast is like and how the microenvironment of cells interact. When further research and greater knowledge is obtained for these techniques, a step towards a cure for different cancers could be made.

Conclusion

Mammalian cell culture has developed since its first uses at the start of the twentieth century and has become an integral unit in the medical research process. Advances, such as the development of 3D cell culture, are constantly made as the struggle of replicating in vivo environments, in vivo, continues. The continuous growth of these new techniques and the refinement of others will cement the vital role of tissue culture in medical research for the foreseeable future.