Providing Technological Solutions for Stem Cell Research

The collaboration between Plasticell, University College London and the National Institute of Biological Standards and Control (NIBSC), has led to step change improvements in stem cell technology and the launch of a next generation product.

This Project was conceived and managed by Chemistry Innovation and provides an excellent example of the benefits of collaborative partnerships, it is also in line with our priority area Product Design. If you would like to find out more about the project or collaborative partnerships, then please contact Colin Tattam, T: 01928 515662.

Background

Stem cells have the capacity to be transformed into any cell type, and so have enormous potential for the development of bioassay systems and also to create tissue for regenerative medicine. In bioassays, stem cells can, for example, vastly improve drug discovery development and toxicology testing: e.g. stem cell derived cardiomyocytes and hepatocytes, expected to account for a major segment of the $1.5bn global drug toxicology market. Stem cells have also been hailed as potential cell treatments for many conditions.

However- how do you turn a stem cell into the type of cell you require? This is typically done by exposing the cells, in culture, to a variety of biochemicals, often using complex mixtures, in a defined sequence at different stages of differentiation.

While some of these recipes are now known, they are often not optimised, and can be very expensive to apply in large scale cell culture. For many target cell types recipes are still to be discovered.

The collaboration between Plasticell, NIBSC and University College London, made step change improvements to Plasticell's CombiCult™ technology, which provides a high throughput screening system designed for the discovery of optimal stem cell differentiation methods.

The project has taken a real step toward answering some of the major limitations of stem cell differentiation, providing the simple, low cost, robust protocols that are needed in producing fully functional cell types for the successful exploitation of stem cells in real-world applications.

The Need

Despite major progress, most differentiation protocols have significant limitations such as:

- being highly sensitive to cell line variations
- the complex and expensive mixtures of chemicals or animal-derived biochemical agents involved
- being operator dependent

This means that there are still many cell types for which we do not yet have "recipes" for successful transformation of stem cells. The improved 'CombiCult™' technology resulting from the project, is vital for the continued UK-based discovery of high value differentiation protocols. The alternative requires running thousands of manual, trial and error experiments, in traditional, high volume cell culture laboratories; this is extremely labour intensive, and would be commercially viable only in countries with very low labour costs.

The Challenges

The project is a great example of the benefits of knowledge transfer from academia to industry. Plasticell's experience was focussed upon high throughput technology and experimentation but it needed the input of specific expertise from the University College London which is a leader in the emerging field of stem cell and regenerative medicine and NIBSC, a UK centre of cell culture and bioassay development.

The Solution

The project has improved all aspects of Plasticell's CombiCult™ work flow processes. Improvements have increased screening throughput, saving more than 6 weeks per screen, reduced operator variability and have allowed operation by less technically skilled operators. The project has resulted in the invention and manufacture of disposable lab-ware for stem cell culture, allowing scientists to carry out all bead manipulations and media changes in a single device.

It has also developed bioinformatics software for data handling and analysis of extremely large cell culture datasets. The software has diverse uses and can additionally be used as a standalone analysis system, providing a breakthrough in the method of interpreting biological mechanistic studies.

Successes

The Market

- The improvements have led to Plasticell launching its second generation CombiCult™ screen, capable of rapidly screening up to ten thousand cell culture media combinations. It is now clear that the project will yield a substantial return on the R&D investment, even with conservative sales projections over the next five years.

- As well as an economical return the project will also provide enormous societal benefits, in new bioassay to support stratified medicine, in regenerative medicine and in new markets; for example differentiation protocols for cord blood storage.

Next Steps

The success of the development of CombiCult™high throughput stem cell screening technology has led to further collaborations with Plasticell;

- The biopharmaceutical company UCB provided Plasticell with drug compound libraries with known biological targets. The screening of compound libraries aims to discover new signaling cell pathways involved in stem cell biology, including tissue re-generation.
- Plasticell has received further funding from the Technology Strategy Board to apply CombiCult™ towards developing a novel cell therapy designed to stimulate and sustain tissue regeneration in collaboration with imperial spin-out company Regregen (project AC100D).
- In addition Plasticell has signed a collaboration agreement with Sigma-Aldrich, who have the technology to engineer human stem cell lines that enable tracking of differentiation to specific mature cell types. Furthering CombiCult™s ability to develop novel stem cell differentiation protocols (project 10315).