Engineering new biomaterials for human implants

Scientists at the University of Applied Sciences in Zurich, Switzerland, are collaborating with Tecan to optimize automated liquid handling systems for cell and tissue culture. The Cell Biology Division at the University's Institute of Chemistry and Biotechnology (ICB) specializes in developing cell culture technologies and tissue engineering, including the *in vitro* development and investigation of biomaterials for bone, cartilage, intervertebral discs, teeth and other connective tissue implants. It is essential that these materials are tested to high standards of quality with minimal variation, so the group has been developing automated tissue culture methods using a Tecan Freedom EVO® liquid handling workstation as part of their research activities.

Professor Dr Ursula Graf-Hausner, Group Leader of the Cell Biology Division, said: "We are collaborating with industrial partners who develop biomaterials, such as titanium-based products, as potential foreign implants. We begin by carrying out *in vitro* studies of these biomaterials and, if the results of our preliminary studies are successful, then the materials proceed to animal model studies and, eventually, to clinical applications. Some of the technologies we use are still in the early stages of development but I believe an essential factor for the success of any method is that it can be automated. Reproducibility is an extremely important part of reaching our clinical goals when working with these materials, and we have started a very good collaboration with Tecan to develop these methods."

The Cell Biology group has been evaluating the capabilities of the Freedom EVO workstation to perform fully automated cell culture, including cell harvesting and plating, for several different cell lines. The Freedom EVO is equipped with a FlaskFlipper™ module for handling the automation-friendly Corning® RoboFlask™ vessels and an Infinite™ F200 luminescence reader for analyzing the cells. It is also configured with a modified, 8-channel liquid handling arm equipped with 5 ml syringes that is capable of both rapid bulk media dispensing and precise low-volume pipetting for reagents, as well as a robotic manipulator arm, and a Te-Shake™ robotic shaker and stirrer.

The group uses a variety of mammalian cell lines and human primary cells for its research and has been testing the Freedom EVO's ability to handle cell types with different adhesion and aggregation characteristics, including mouse fibroblasts (moderate adherence and aggregation), human osteogenic sarcoma (SaOS-2) cells (strong culture flask attachment and aggregation) and human breast adenocarcinoma (MCF-7) cells (weak attachment to flasks, moderate aggregation). The harvesting efficiencies of the workstation and the viabilities of the cultured cells were compared to manually obtained results, and it was found that the automated methods achieved comparable or better reproducibility and viability of cells than manual methods[1] (see Figure 1).

Dr Stephanie Mathes, research scientist in the Cell Biology group, has been running the Freedom EVO workstation, and said: "The flexibility of the Freedom EVO is really positive and specific design features can easily be added to suit a customer's application. I particularly like the Freedom EVOware® software; it is very easy to operate and you can simply drag and drop icons to create a whole new automated procedure. We have plans for more projects now that we've seen the true flexibility of Tecan's workstation and all its possibilities."

"The collaboration we have with Tecan is very close and we have really been able to share our knowledge and experiences," Professor Graf-Hausner added. "For example, in some instances we have achieved better data by using slightly different volumes of reagents and have passed this on to Tecan for optimizing the system." The team has recently developed a range of complete, automated cell harvesting and plating protocols that will accommodate different operating conditions, such as the time required for the cells to detach from culture flasks,

From left to right: Lorenz Wohlwend, Stephanie Mathes and Ursula Graf-Hausner.

to suit a variety of cell types. The results generated are easily transferable to other Tecan cell culture equipment such as the Cellerity™.

"The automated system saves us a lot of time in preparing cells, not least because we can leave it to run unattended over the weekends and during holiday periods," Professor Graf-Hausner continued. "This is a huge advantage for members of our team, including several students, who would normally be manually pipetting the cells, as they can now spend their time doing much more interesting and sophisticated tasks. The collaboration as a whole has given them an excellent insight into the early steps of process development, and the system itself shows what cell culture technology and tissue engineering research might involve in the future and how new technology will really make our lives much easier in the laboratory."

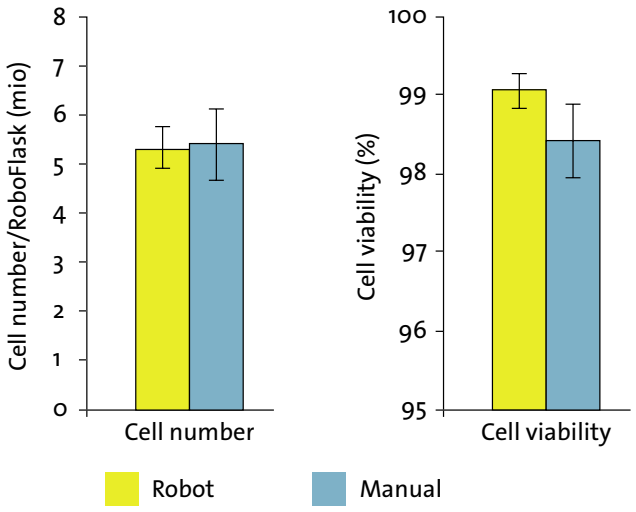

Figure 1
SaOS-2 cells were harvested manually and automatically by a Freedom EVO workstation equipped with a FlaskFlipper and Corning® RoboFlask™ vessels. Cell number and viability were compared. Repeatability of the process and viability of the harvested cells were higher for the automated process.

Reference:

1. Graf-Hausner U, Mathes S, Baumgartner S, Mueller U (2007). Automated processing of cell cultures on the Tecan Freedom EVO robotic workstation. Poster presented at ALA 2007.
Further details of the study are available at www.tecan.com