Rapid Characterization and Quality Control of Cell Proliferation

-SPECCs shedding light on Culture Media Solutions-

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Introduction

Cell culture has become one of the major tools used in life science today. In addition to the study of cell functions for fundamental research, the uses of cell lines for the production of pharmaceutical substances or the applications of cells for the assessment of cytotoxicity of materials are of great importance. Thus, quality control and standardization have become indispensable tools in cell culture laboratories. Evaluating the general health or "happiness" of a cell culture is usually based on different cell characteristics: morphology, growth rate and expression of special functions. However, in order to determine if a proposed cell line is suitable for a typical biological assay, reliable and robust analytical techniques are necessary. FT-Infrared (FT-IR) spectroscopy in combination with chemometric methods proves to be highly advantages for this purpose.

The presented study demonstrates that by using well-established chemometric methods like PCA in conjunction with infrared spectroscopy one can generate a simple and effective identification and quality assessment methodology for the complex constituents of different cell media solutions and therefore monitor the status of cell quality.

Experimental Setup

Figure 1: Picture of the FT-IR SPECCs analyzer (left) and patented flow-through transmission cell (right).

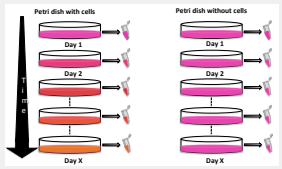

Figure 2: Scheme of the setup.

The SPECCs analyzer is a simple, rapid and cost-effective solution for the characterization of cell quality based on the culture media solutions. The instrument is based on the mid-IR spectral range, the centerpiece is a flow-through transmission cell, consisting of a path length of approx. 7 µm and therefore optimized for the measurement of aqueous solutions.

Results and Discussion

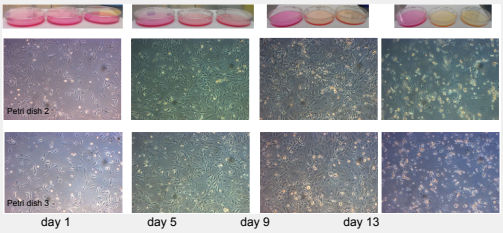

Figure 3: A visual comparison of the cell growth of Balb/3T3 cells and culture media solutions as a function of time; Petri dish 1: culture media, Petri dish 2 and 3: Balb/3T3 cells.

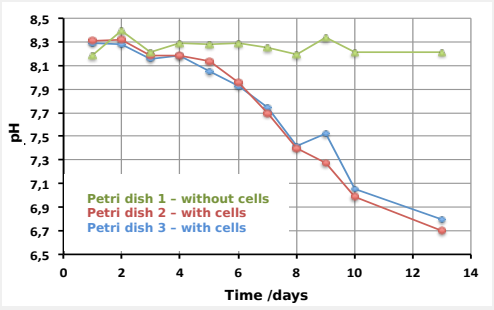

Figure 4: Time-dependent pH changes of the culture media solutions.

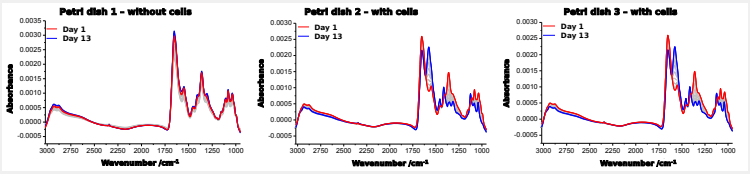

Figure 5: Time-dependent FT-IR spectral changes of the culture media soultions without cells (left) and with cells (center and right).

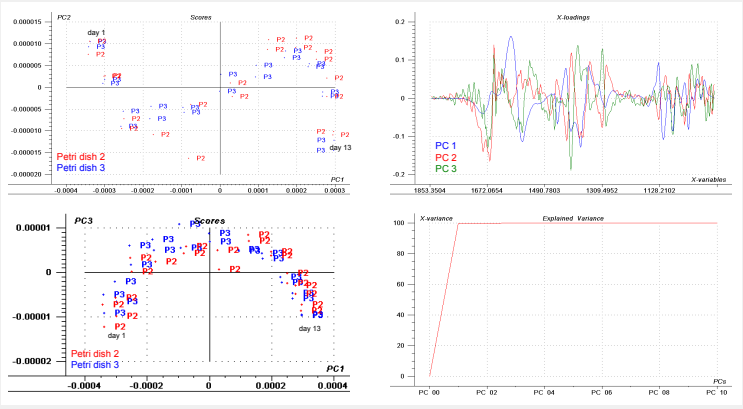

Figure 6: PCA analysis using first-derivative FT-IR spectra of the culture media solutions of Balb/3T3 cells.

Conclusions

This study demonstrate that by using relatively simple and well established chemometric methods in conjunction with FT-IR spectroscopy one can generate a simple and effective identification and quality assessment methodology for the complex constituents of cell culture media solutions. FT-IR spectroscopy proved to be highly advantageous for this purpose and the observed spectral reproducibility is excellent once appropriate pre-processing techniques were applied.

Additionally, the SPECCs analyzer is a simple, rapid and cost-effective solution for the characterization of cell quality based on the culture media solutions. Furthermore, the spectrometer has the advantages of minimal sample preparation and the ability to analyze aqueous samples. Furthermore, FT-IR spectroscopy in combination with chemometric applications has the potential to be extremely useful in an industrial context for "in house" sample handling, tracking and quality control of cell cultures.