

INTERACTIVE VIZUALIZATION OF CELL EXPANSION PROCESS PERFORMANCE

Toon Lambrechts, M3-BIORES: Measure, Model and Manage Bioresponses, KU Leuven
toon.lambrechts@biw.kuleuven.be

Maarten Sonnaert, Prometheus, Division of Skeletal Tissue Engineering, KU Leuven

Jan Schrooten, Prometheus, Division of Skeletal Tissue Engineering, KU Leuven

Frank P. Luyten, Skeletal Biology and Engineering Research Centre, KU Leuven

Jean-Marie Aerts, M3-BIORES: Measure, Model and Manage Bioresponses, KU Leuven

Ioannis Papantoniou, Skeletal Biology and Engineering Research Centre, KU Leuven

Key Words: Large-scale cell culture, mesenchymal stem cells, data visualization, process comparability.

As cell-based technologies are rapidly evolving beyond the laboratory scale, the demand for mass production of high quality cells is increasing. Unfortunately, only limited amounts of cells can be sourced from (human) donors. Therefore sequences of cell expansion steps are required to multiply the original number of cells taken from the donor biopsy to the amounts required for clinical application. Currently a large variety of expansion processes are used and described in literature. However, it is extremely difficult to compare them as many mesenchymal stem cell (MSC) subtypes are used in different culture vessels, with different medium compositions, etc. Moreover, adding to this variation in expansion strategies, within one process there can be significant fluctuations in outcome due to process variability and inherent donor-to-donor related variability.

The aim of this work was to analyze the performance of a range of expansion processes for large-scale MSC expansion. Therefore a literature-based study was performed, currently resulting in a database of 73 individual cell expansion processes in 5 different types of culture vessels (microcarrier, (layered) flasks, hollow fiber-, multiplate-, and packed bed-bioreactor), 6 different types of MSCs and many different media compositions. The scale of the processes in terms of final cell numbers ranged between 7.5×10^6 and 1.1×10^{10} cells. An interactive process map was created where the scale, efficiency, cell type, culture method and load on downstream processing can be explored (see figure below). This interactive visualization tool provides an integrated perspective on the different culture processes and is able to increase the understanding on process comparability, attainable cell yield, scale-up strategies and the effect of certain critical process parameters on the expansion result.

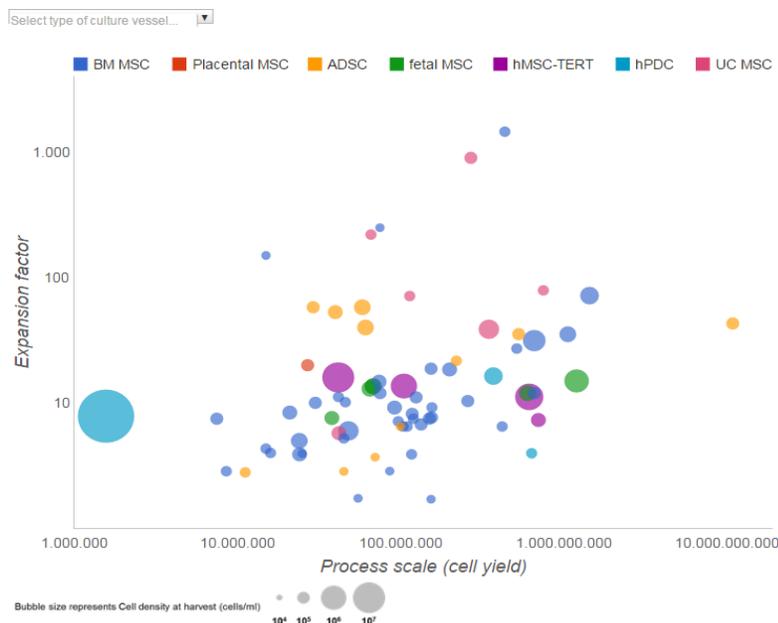


Figure 1 – Screenshot of the interactive process map. The y-scale indicates the expansion factor, the x-scale indicates the total cell yield, the color of the dots indicates the specific MSC subtype. The size of the circle indicates final cell density (cells/mL) before the cell harvest step. BM = bone marrow, ADSC = adipose-derived stem cell, hPDC = human periosteum derived stem cell, UC = umbilical cord.