Cultivation of Hematopoietic Stem and Progenitor Cells: Biochemical Engineering Aspects

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Dedicated to Prof. Dr. Wolf-Dieter Deckwer on the occasion of his 60th birthday

The ex vivo expansion of hematopoietic cells is one of the most challenging fields in cell culture. This is a rapidly growing area of tissue engineering with many potential applications in bone marrow transplantation, transfusion medicine or gene therapy. Over the last few years much progress has been made in understanding hematopoietic differentiation, discovery of cytokines, isolation and identification of cellular subtypes and in the development of a variety of bioreactor concepts. All this has led to a number of (preliminary) clinical trials that gave a hint of the benefits that can be obtained from the use of expanded hematopoietic cells in therapy. Moreover, as we understand the complexity and the regulation of hematopoiesis, it becomes obvious that highly sophisticated cultivation techniques and bioreactor concepts are needed: a new challenge for bioprocess engineering in cell culture.

Keywords. Hematopoietic cell culture, Stem and progenitor cells, Ex vivo expansion, Bioprocess engineering

1 Introduction ......................................................... 113

2 The Hematopoietic System ................................. 113

2.1 Sources of Hematopoietic Cells .................. 115
2.2 Potential Medical Applications .................. 116

3 Cultivation Parameters ............................................ 117

3.1 Cytokines .......................................................... 117
3.2 Culture Media and Feeding Schedules ............... 118
3.3 Oxygen Tension .............................................. 118
3.4 pH ................................................................. 119
3.5 Osmolality ...................................................... 119
3.6 Biocompatibility of Materials ...................... 120

* To whom all correspondence should be adressed.
4 Concepts of Cultivation ........................................ 120

4.1 Cultivation of Isolated Stem and Progenitor Cells .......... 121
4.2 Cultivation with Stromal Cells or Stroma-Derived Factors .... 123

5 Conclusions and Outlook ........................................ 125

References .......................................................... 125

Abbreviations

BFU-E  burst-forming unit erythroid
BM  bone marrow
CAFC  cobblestone-area-forming cell
CB  cord blood
CD  cluster of differentiation
CFC  colony-forming cell
CFU  colony-forming unit
CFU-Ba  CFU basophil
CFU-Eo  CFU eosinophil
CFU-E  CFU erythrocyte
CFU-G  CFU granulocyte
CFU-GEMM  CFU granulocyte/erythrocyte/macrophage/megacaryocyte
CFU GM  CFU granulocyte/macrophage
CFU-M  CFU macrophage
CFU-Meg  CFU megacyctocyte
CMV  cytomegalovirus
EBV  Epstein-Barr virus
Epo  erythropoietin
G-CSF  granulocyte-colony-stimulating factor
GM-CSF  granulocyte-macrophage colony-stimulating factor
GVHD  graft-versus-host disease
HSC  hematopoietic stem cell
IL  interleukin
LTC-IC  long-term-culture initiating cell
mM  millimole per liter
MNC  mononuclear cell
MPB  mobilized peripheral blood
MRC  mouse-repopulating cell
M-CSF  macrophage colony-stimulating factor
NK  natural killer
NOD-SCID  non-obese diabetic severe combined immune deficiency
PS  polystyrene
SCEPF  stem cell expansion promoting factor
SCF  stem cell factor
SCM  stromal-conditioned medium
SDF-1  stromal-derived factor 1