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Cell Culture Technology

Springer

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Preface

Cell culture technology has rapidly evolved over the past half century and thus cannot be "limited" any more to the classical fermentation and animal production cell line culture technologies. Nowadays, methods comprise also of modern 3D techniques for cell expansion and/or differentiation. The approaches for tissue engineering and cell-based therapies have woken the demand of cultivation strategies beyond standard cell culture methods. These include the development and establishment of suitable protocols for cultivating cells – especially primary cells – under physiological conditions.

This textbook is structured into 10 different chapters: brief history of the developments in mammalian cell culture technology until today including stem cell cultivation; introduction to relevant equipment and consumable materials as well as standard techniques used in cell culture labs; outline on requirements, developments, and current status in media design; summary of tumor cell line and tissue cultivation; introduction of 3D culture techniques for tissue engineering and cell-based testing systems; overview on relevant biomaterials and their characteristics; demonstration of mechanisms and effects involved in cell-surface interaction; definition and discussion on physiological conditions with focus on oxygen in cell culture procedures; overview on different co-culture systems; and an introduction to suitable strategies for automation of cell culture procedures.

This textbook is a unique collection of chapters relevant for modern cell culture technology, providing an excellent overview of the "essentials" and the current paradigms, as well as insights into relevant methods underlying modern cell culture technology. The chapters are based on lectures and teaching material of the authoring teams, thus making the textbook excellently suitable for teaching and to support bachelor, master, and doctoral theses.

Notwithstanding, if the reader already has experience in mammalian cell culture, or he or she is a novice to this field, this book will be a valuable reading, which will deepen knowledge and expand the understanding how modern cell culture works.

We thank all authors of this book who in addition to their daily chores and academic work helped us with their brilliant and outstanding contributions.

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June 2018

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Abbreviations

AFM	Atomic force microscopy
AIA	Activation-induced apoptosis
ALS	Amyotrophic lateral sclerosis
APCs	Antigen-presenting cells
Asn	Asparagine
ATMPs	Advanced therapy medicinal products
ATP	Adenosine triphosphate
BAL	Bioartificial liver
BG	Bioactive glasses
BHK	Baby hamster kidney
BMP	Bone morphogenetic protein
BrdU	Bromodeoxyuridine
CAD	Computer-aided design
CAR-T cells	Chimeric antigen receptor T cells
CD	Cluster of differentiation
CFSE	Carboxyfluorescein succinimidyl ester
CO_2	Carbon dioxide
CoC	Ceramic-on-ceramic
CFU	Colony forming units
CHO	Chinese hamster vary
µCT/nCT	Micro-/nano-computer tomography
DAPI	4′,6-Diamidino-2-phenylindole
DHFR	Dihydrofolatreduktase
DMEM	Dulbecco's Modified Eagle Medium
DMSO	Dimethyl sulfoxide
DNA	Deoxyribonucleic acid
rDNA	Recombinant DNA
DO	Dissolved oxygen
DPN	Diphosphopyridine nucleotide
EBV	Epstein-Barr virus
ECM	Extracellular matrix
EDTA	Ethylenediaminetetraacetic acid
EL	Extra-luminal
ELISA	Enzyme-linked immunosorbent assay
EMEM	Eagle's Minimum Essential Medium
EPI	Epiblast
EPO	Erythropoietin
ESCs	Embryonic stem cells
ETO	Ethylene oxide
FACS	Fluorescence-activated cell sorting
FAD	Flavin adenine dinucleotide
FBS	Fetal bovine serum
FDA	Food and Drug Administration
FEM	Finite element method
FGF	Fibroblast growth factor
FLIM	Fluorescence lifetime imaging microscopy
FMD	Foot-and-mouth disease
FRET	Förster resonance energy transfer
G6PD	Glucose-6-phosphate dehydrogenase
G-CSF	Granulocyte colony-stimulating factor
GCP	Good clinical practice
GFP	Green fluorescent protein
GMP	Good manufacturing practice
GOI	Gene of interest
GVHD	Graft-versus-host disease
HA	Hydroxyapatite
HBSS	Hank's buffered salt solution
HEPES	4-(2-Hydroxyethyl)-1-piperazineethanesulfonic acid
HFB	Hollow fiber bioreactors
HPV	Human papilloma virus
HPL	Human platelet lysate
HSCs	Hematopoietic stem cells
ICM	Inner cell mass
IL	Intraluminal
iPSCs	Induced pluripotent stem cells
IMDM	Iscove's Modified Dulbecco's Medium
ITS	Insulin-transferrin-sodium selenite
LC-MS	Liquid chromatography–mass spectrometry
LCL	Lymphoblastoid cell lines

LCST	Lower critical solution temperature
LDH	Lactate dehydrogenase
Mab	Monoclonal antibody
MACS	Magnetic bead-associated cell sorting
MEF	Mouse embryonic fibroblasts
MHC	Major histocompatibility complex
MLC	Mixed lymphocyte culture
MLR	Mixed lymphocyte reaction
MoM	Metal-on-metal
MRI	Magnetic resonance imaging
MSCs	Mesenchymal stem cells, mesenchymal stromal cells
MTT	3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide
NK	Natural killer
NSCs	Neural stem cells
O_2	Oxygen
OCTGT	Office of Cellular, Tissue, and Gene Therapies
PBMC	Peripheral blood mononuclear cell
PBS	Phosphate-buffered saline
PE	Polyethylene
PGE2	Prostaglandin E2
PGM	Phosphoglucomutase
PID controller	Proportional-integral-derivative controller
PrE	Primitive endoderm
PI	Propidium iodide
PCR	Polymerase chain reaction
PS	Polystyrene
PSCs	Pluripotent stem cells
tPA	Tissue plasminogen activator
PMMA	Poly(methyl methacrylate)
PVC	Polyvinyl chloride
RNA	Ribonucleic acid
RPMI	Roswell Park Memorial Institute
SCID	Severe combined immunodeficient
SDS	Sodium dodecyl sulfate
SEM	Scanning electron microscopy
Ser	Serine
scFv	Single-chain variable fragment
SCF	Stem cell factor
STR	Short tandem repeat
TAA	Tumor-associated antigen
TCP	Tricalcium phosphate
TE	Tissue engineering
hTERT	Human telomerase reverse transcriptase
TGF	Transforming growth factor
TME	Tumor microenvironment
TPN	Triphosphopyridine nucleotide
TPO	Thrombopoietin
UV	Ultraviolet
VEGF	Vascular endothelial growth factor
WST	Water soluble tetrazolium
7AAD	7-Aminoactinomycin
2D	Two-dimensional
3D	Three-dimensional