

# METHODS IN PHARMACOLOGY AND TOXICOLOGY

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# Apoptosis Methods in Toxicology

Edited by

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## Preface

Apoptosis is a highly regulated and active form of programmed cell death that is used to eliminate excess, damaged, or cancerous cells throughout life in a variety of organisms, thus maintaining normal homeostasis. Inappropriate apoptosis may occur within cells in response to various toxicological stresses, including drugs and other compounds. Since dysregulated apoptosis is likely to result in disease, it is important to quantitate the level of apoptosis and determine its mechanisms and signaling pathways through suitable apoptotic methods.

The most suitable methods for detecting and quantitating apoptosis must be able to distinguish apoptosis from other more recently discovered forms of programmed cell death, such as programmed necrosis and autophagic cell death. Apoptosis is characterized by specific morphological and biochemical changes, and is executed principally through the mitochondria and death receptor pathways. Thus, the most appropriate and useful methods for the specific analysis of and quantitation of apoptosis must measure as many apoptosis parameters as possible, in addition to distinguishing apoptosis from other forms of cell death, such as autophagy and necrosis. Mechanisms underlying apoptosis and other forms of programmed cell death have been the focus of toxicology, as well as many scientific fields, within the past decade. This has spiked recent developments as well as updates in time-tested apoptosis methods.

*Apoptosis Methods in Toxicology* is designed to provide a single, valuable reference source for methods that definitively identify and accurately quantify apoptosis. Experts in the field have been recruited to provide extensive reviews and references of time-tested, recently updated, and newly developed apoptosis methods in toxicology. In addition to relevant reviews, authors provide a detailed step-by-step description of their best state-of-the-art, time-tested, recently developed, and updated techniques for studying apoptosis in toxicology. Technical problems, challenges, and limitations of the methods are also discussed. This volume, which is designed for the novice as well as the expert in toxicology and other related fields, is divided into four interrelated and overlapping sections. The introduction section (Chaps. 1 and 2) contains reviews on the most common methods utilized to detect and quantitate apoptosis, as well as apoptosis signaling pathways in toxicological and other related research. This is an excellent introductory section for the novice scientist. The second section focuses on multiparametric and phased apoptosis assays for detecting early and late apoptosis (Chaps. 3 and 4), or distinguishing apoptosis from necrosis and autophagy (Chap. 5). The third section focuses on recent advances in real time and high-throughput assays to detect and quantitate apoptosis (Chaps. 6–10) and apoptosis signaling pathways (Chap. 11). This section covers apoptosis assays that utilize low-end instrumentation that can be found in most laboratories, as well as methods that rely on high-end sophisticated instrumentation. The last section of the book reviews recent developments in preclinical anticancer therapeutics targeting apoptosis. Chapter 12 focuses on the interrelationship of preclinical anticancer small molecules with apoptosis and autophagy. Chapter 13 discusses

the enhancement of cancer cell death subroutine therapeutic effects of small molecules through the use of various liposome formulations. Thus, the content, as organized, can be utilized by novice scientists as well as experts, utilizing a range of instruments from common laboratory equipment to high-end expensive and automated machinery capable of performing real time apoptotic measurements.

*Greensboro, NC, USA*

*Perpetua M. Muganda*

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