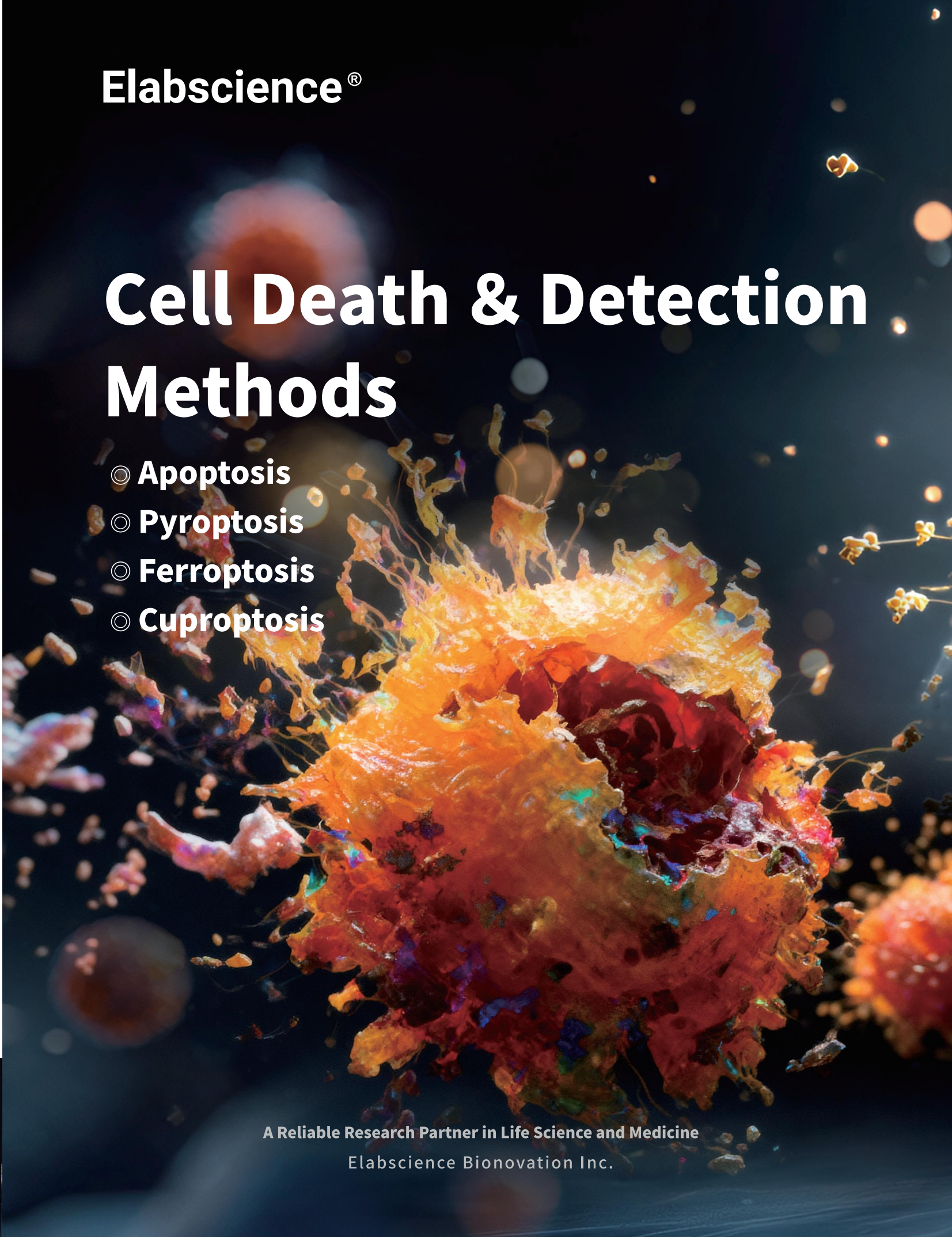
Elabscience®

Cell Death & Detection Methods

- Apoptosis
- Pyroptosis
- Ferroptosis
- Cuproptosis



A Reliable Research Partner in Life Science and Medicine

Elabscience Bionovation Inc.

Apoptosis

Introduction

Apoptosis, also known as programmed cell death is an actively regulated process controlled by genes that are involved with the activation, expression, and regulation. In contrast to necrosis, apoptosis does not release cellular contents into the surrounding environment, making it distinctly different from necrotic cell death.

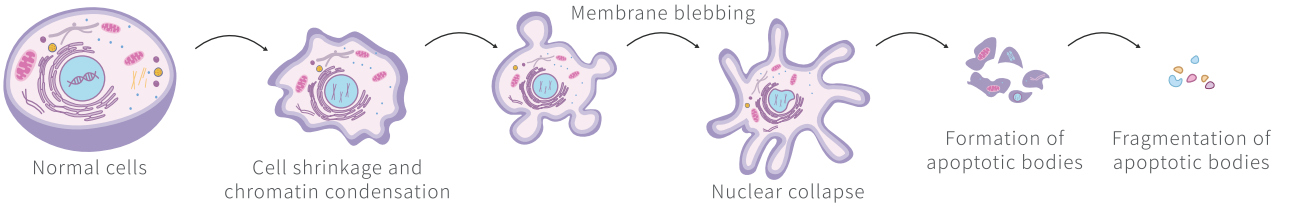


Fig. 1. Key stages of the apoptotic pathway

Detection Methods for Apoptosis

Annexin V Assay for Phosphatidylserine (PS) Externalization: During early apoptosis, phosphatidylserine (PS), normally located on the inner leaflet of the plasma membrane, translocates to the outer surface. Annexin V is a protein that binds specifically to PS. By using fluorescently-labeled-Annexin V to detect this externalized PS, apoptosis can be assessed through fluorescence signal detection.

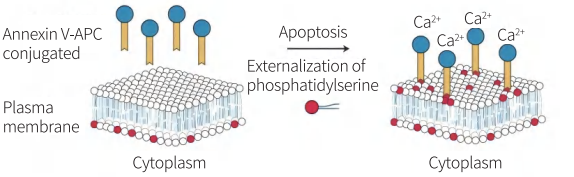


Fig. 2. Mechanism of Annexin V binding during early apoptosis

Detection of Activated Apoptosis-Related Proteins: After the initiation of apoptosis, distinct intracellular proteins associated with the process become activated, such as Bcl-2, TNF-α, and FASL/TNFSF6. Techniques such as ELISA can be employed to measure these activated proteins, providing an indication of apoptotic status.

Caspase Enzyme Activity Assay: In the early stages of apoptosis, Caspase enzymes, which are present in the cytoplasm, become activated and trigger a cascade of apoptotic reactions. Apoptosis can be evaluated by measuring the activity of these Caspase enzymes.

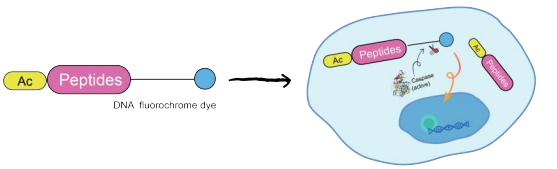


Fig. 3. Proteolytic cascade driving apoptotic cell execution

JC-1 Assay for Mitochondrial Membrane Potential (ΔΨm) Changes: In healthy cells with high mitochondrial membrane potential, JC-1 accumulates in the mitochondrial matrix and forms aggregates that emit red fluorescence. During apoptosis, the loss of mitochondrial membrane potential prevents JC-1 aggregation, resulting in its presence as green fluorescent monomers. This fluorescence shift is used to detect apoptosis.

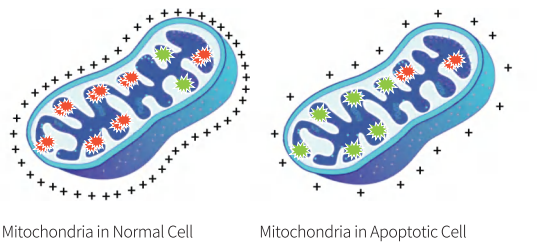


Fig. 4. Fluorescence shifts due to mitochondrial depolarization in apoptosis

TUNEL Assay for DNA Fragmentation: In late stages of apoptosis, DNA fragmentation occurs. The terminal deoxynucleotidyl transferase (TdT) enzyme catalyzes the binding of fluorochrome-labeled dUTP to the exposed 3'-OH ends of the broken DNA strands. The TUNEL assay kit detects this DNA fragmentation, identifying cells in the late phase of apoptosis.

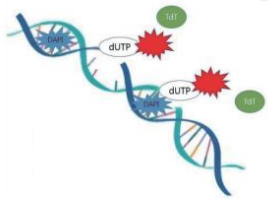


Fig. 5. DNA fragmentation as a hallmark of apoptosis

▶Recommended Apoptosis Detection Products (Partial)

Product Name	Cat. No.	Instrument*			
		FCM	SPC	MR	FM
Annexin V-FITC/PI Apoptosis Kit	E-CK-A211	✓			
Caspase 3/7 Activity Assay Kit(Colorimetric Method)	E-CK-A383		✓	✓	
Caspase 8 Activity Assay Kit(Colorimetric Method)	E-CK-A388		✓	✓	
Caspase 9 Activity Assay Kit(Colorimetric Method)	E-CK-A389		✓	✓	
Caspase 3/7 Activity Detection Substrate for Flow Cytometry	E-CK-A483	✓			✓
Human BAX(Bcl-2 Associated X Protein) ELISA Kit	E-EL-H0562			✓	
Human FASL/TNFSF6(Factor Related Apoptosis Ligand) ELISA Kit	E-EL-H0068			✓	
Human TNF-α(Tumor Necrosis Factor Alpha) ELISA Kit	E-EL-H0109			✓	
Mitochondrial Membrane Potential Assay Kit (with JC-1)	E-CK-A301	✓			✓
One-step TUNEL Flow Cytometry Apoptosis Kit (Green, Elab Fluor® 488)	E-CK-A421	✓			✓
One-step TUNEL Flow Cytometry Apoptosis Kit (Red, Elab Fluor® 594)	E-CK-A422	✓			
One-step TUNEL In Situ Apoptosis Kit (Green, FITC)	E-CK-A320				✓

For more apoptosis-related products, please visit www.elabscience.com or contact your local distributor.

Instrument Abbreviation Key*	
Abbreviation	Full Name
FCM	Flow Cytometer
FM	Fluorescence Microscope
MR	Microplate Reader
SPC	Spectrophotometer

▶Product Citations (Partial)

Citation	Journal	Product Name
Gao W, Wang Q, Li S, et al. Promising therapeutic efficacy and safety of a novel integrin α6-targeting peptide-drug conjugate in lung adenocarcinoma. *Mol Cancer*. 2025;24(1):190. Published 2025 Jul 5. doi:10.1186/s12943-025-02395-7	*Molecular Cancer*	Annexin V-FITC/PI Apoptosis Kit (E-CK-A211)
Qin T, Qin Y, Wen H, et al. Hypoxic Neural Stem Cells Enhance Spinal Cord Repair Through HIF-1a/RAB17-Driven Extracellular Vesicle Release. *J Extracell Vesicles*. 2025;14(7):e70126. doi:10.1002/jev2.70126	*Journal of Extracellular Vesicles*	One-step TUNEL In Situ Apoptosis Kit (Red, Elab Fluor® 647) (E-CK-A324)
Wu Y, Zhang Y, Yu Y, et al. Small intestinal γδ T17 cells promote SAE through STING/C1q-induced microglial synaptic pruning in male mice. *Nat Commun*. 2025;16(1):6779. Published 2025 Jul 23. doi:10.1038/s41467-025-62181-3	*Nature Communications*	Mitochondrial Membrane Potential Assay Kit (with JC-1) (E-CK-A301)

For more citation information, please visit www.elabscience.com.

Pyroptosis

Introduction

Pyroptosis, also known as inflammatory cell death, is a form of programmed cell death characterized by continuous cell swelling until the cell membrane ruptures, leading to the release of cellular contents and a large number of inflammatory factors, thereby triggering a strong inflammatory response. As a crucial innate immune response in the body, pyroptosis plays a significant role in combating infections. Under light microscopy, pyroptotic cells appear swollen and enlarged, with numerous bubble-like protrusions (pyroptotic bodies).

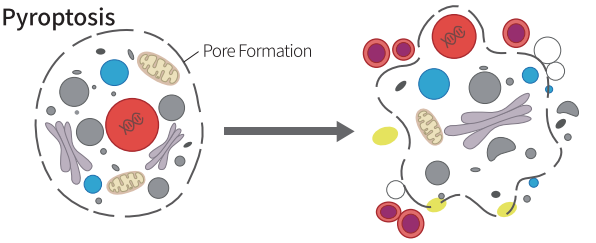


Fig. 6. Pyroptotic cell death via membrane rupture and cytokine release

Detection Methods for Pyroptosis

ELISA Method: During pyroptosis, factors such as IL-1β, IL-18, and caspases are activated. These cytokines can be detected using the ELISA method.

Protein Detection: The occurrence of pyroptosis can be determined by detecting pyroptosis-related proteins, such as Caspase-1, Caspase-4, IL-1β, IL-18, and other proteins involved in the pyroptosis pathway (e.g., AIM2).

Caspase Enzyme Activity Assay: Caspase assay kits can be used to detect the activity of Caspase-1 and Caspase-4 enzymes in cells via spectrophotometry, allowing for the observation of pyroptosis occurrence.

▶Recommended Pyroptosis Detection Products (Partial)

Product Name	Cat. No.	Instrument*			
		FCM	SPC	MR	FM
Caspase 1 Activity Assay Kit(Colorimetric Method)	E-CK-A381		✓	✓	
Caspase 4 Activity Assay Kit(Colorimetric Method)	E-CK-A384		✓	✓	
Caspase 1 Activity Detection Substrate for Flow Cytometry	E-CK-A481	✓			✓
Caspase 4 Activity Detection Substrate for Flow Cytometry	E-CK-A484	✓			✓
Human IL-1β(Interleukin 1 Beta) ELISA Kit	E-EL-H0149			✓	
Human IL-18(Interleukin 18) ELISA Kit	E-EL-H0253			✓	
Human CASP1(Caspase 1) ELISA Kit	E-EL-H0016			✓	
Human CASP4(Caspase 4) ELISA Kit	E-EL-H0660			✓	
Mouse IL-1β(Interleukin 1 Beta) ELISA Kit	E-EL-M0037			✓	
Mouse IL-18(Interleukin 18) ELISA Kit	E-EL-M0730			✓	

For more pyroptosis-related products, please visit www.elabscience.com or contact your local distributor.

Instrument Abbreviation Key*	
Abbreviation	Full Name
FCM	Flow Cytometer
FM	Fluorescence Microscope
MR	Microplate Reader
SPC	Spectrophotometer

▶Product Citations (Partial)

Citation	Journal	Product Name
Kang M, Du W, Ding L, Wu M, Pei D. HIC1 suppresses Tumor Progression and Enhances $CD8^+$ T Cells Infiltration Through Promoting GSDMD-induced Pyroptosis in Gastric Cancer. *Adv Sci* (Weinh). 2025;12(26):e2412083. doi:10.1002/advs.202412083	*Advanced Science*	Human IL-1β(Interleukin 1 Beta) ELISA Kit (E-EL-H0149)
Liang H, Jiang J, Miao J, et al. A Biomimetic Sweeping Microrobot for Active Therapy of Ulcerative Colitis. *Adv Mater*. 2025;37(10):e2402579. doi:10.1002/adma.202402579	*Advanced Materials*	Mouse IL-1β(Interleukin 1 Beta) ELISA Kit (E-EL-M0037)
Qing W, Chen H, Ma X, et al. Gut dysbiosis-induced vitamin B6 metabolic disorder contributes to chronic stress-related abnormal behaviors in a cortisol-independent manner. *Gut Microbes*. 2025;17(1):2447824. doi:10.1080/19490976.2024.2447824	*Gut Microbes*	Mouse IL-18(Interleukin 18) ELISA Kit (E-EL-M0730)

For more citation information, please visit www.elabscience.com.

Ferroptosis

Introduction

Ferroptosis is a form of regulated cell death caused by an imbalance between the generation and degradation of lipid reactive oxygen species in cells. It is characterized by iron dependence, featuring an increase in free ferrous ions and the accumulation of lipid peroxides. Ferroptosis is regulated by multiple cellular metabolic pathways, including redox homeostasis, iron metabolism, mitochondrial activity, and the metabolism of amino acids, lipids, and sugars.

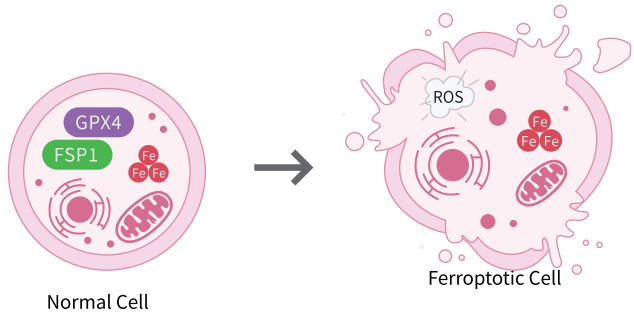


Fig. 7. Iron- and ROS-mediated cytoplasmic damage driving ferroptosis

Detection Methods for Ferroptosis

Morphological Observation: Ferroptosis can be observed through morphological methods, primarily characterized by smaller mitochondria within the cell, reduction or disappearance of mitochondrial cristae, and rupture of the plasma membrane.

Genetic Detection: The activation of genes such as PTGS2, CHAC1, and NFE2L2 can be detected to assess ferroptosis.

Protein Detection: Changes in the expression levels of proteins like ACSL4, GPX4, and TFRC can be measured to monitor the occurrence of ferroptosis.

Metabolic Assays: Detection kits for indicators such as ferrous iron, LPO, and GSH can be used for metabolic analysis to evaluate cellular ferroptosis.

ELISA-Based Detection: ELISA kits for markers like TF, TfR, and NFE2L2 can be employed to detect and assess ferroptosis in cells.

▶Recommended Ferroptosis Detection Products (Partial)

Product Name	Cat. No.	Instrument*	
		FCM	MR
Cell Total Iron Colorimetric Assay Kit	E-BC-K880-M		✓
Cell Ferrous Iron Colorimetric Assay Kit	E-BC-K881-M		✓
Glutathione Peroxidase 4 (GPX4) Activity Assay Kit	E-BC-K883-M		✓
Lipid Peroxide (LPO) Fluorometric Assay Kit	E-BC-F003	✓	
Lactate Dehydrogenase (LDH) Cytotoxicity Colorimetric Assay Kit	E-BC-K771-M		✓
Reactive Oxygen Species (ROS) Fluorometric Assay Kit (Green)	E-BC-K138-F	✓	
Reduced Glutathione (GSH) Colorimetric Assay Kit	E-BC-K030-M		✓

For more ferroptosis-related products, please visit www.elabscience.com or contact your local distributor.

Instrument Abbreviation Key*	
Abbreviation	Full Name
FCM	Flow Cytometer
MR	Microplate Reader

▶Product Citations (Partial)

Citation	Journal	Product Name
Jiang X, Ren Y, Huang C, et al. ZnO Nanoparticle Exposure Disrupted Iron-Sulfur Protein Functions to Increase Macrophage Erythrophagocytosis and Disturb Systemic Iron Recycling. *ACS Nano.* 2025;19(19):18450-18465. doi:10.1021/acsnano.5c01592	*ACS Nano*	Cell Total Iron Colorimetric Assay Kit (E-BC-K880-M)
Liu X, He J, Ying H, et al. Targeting PFKFB4 Biomimetic Codelivery System Synergistically Enhances Ferroptosis to Suppress Small Cell Lung Cancer and Augments the Efficacy of Anti-PD-L1 Immunotherapy. *Adv Sci* (Weinh). 2025;12(22):e2417374. doi:10.1002/advs.202417374	*Advanced Science*	Cell Ferrous Iron Colorimetric Assay Kit (E-BC-K881-M)
Pan X, Chen K, Gao W, et al. Circular RNA circBNC2 inhibits tumorigenesis by modulating ferroptosis and acts as a nanotherapeutic target in prostate cancer. *Mol Cancer.* 2025;24(1):29. Published 2025 Jan 24. doi:10.1186/s12943-025-02234-9	*Molecular Cancer*	Malondialdehyde (MDA) Colorimetric Assay Kit (Cell Samples) (E-BC-K028-M)

For more citation information, please visit www.elabscience.com.

Cuproptosis

Introduction

Cuproptosis is a novel form of cell death triggered by excessive intracellular copper binding directly to lipid-acylated components of the tricarboxylic acid (TCA) cycle, inducing proteotoxic stress and ultimately leading to cell death. Its primary characteristic is the accumulation of cellular copper. Cuproptosis is regulated by cellular metabolic pathways such as the TCA cycle, copper metabolism, and the electron transport chain (ETC).

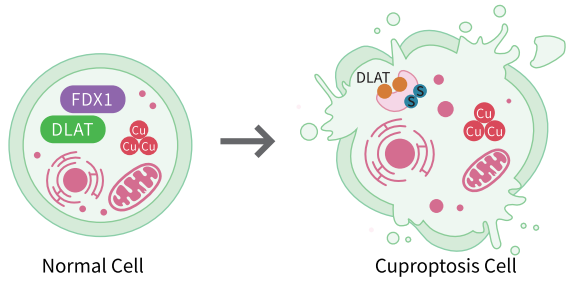


Fig. 8. Cuproptotic cell death via copper-induced protein aggregation and cytoplasmic damage

▶Detection Methods for Cuproptosis

Morphological Observation: Cuproptosis can be observed through morphological methods, characterized by mitochondrial rupture and loss of plasma membrane integrity.

Genetic Detection: Activation of genes such as FDX1, DLAT, and LIAS can be detected to monitor cuproptosis.

Protein Detection: Changes in the expression levels of HSP70, Fe-S cluster proteins, and CTR1 can be measured to assess cuproptosis.

Metabolic Assays: Detection kits for copper, α-ketoglutarate, and GSH can be used for metabolic analysis to evaluate cuproptosis.

ELISA-Based Detection: ELISA kits for indicators such as HIF-1α, HSP70/HSPA9, and GSH can be employed to detect cellular cuproptosis.

▶Recommended Cuproptosis Detection Products (Partial)

Product Name	Cat. No.	Instrument*	
		FMPR	MR
α-Ketoglutarate (α-KG) Fluorometric Assay Kit	E-BC-F047	✓	
Cell Copper (Cu2+) Colorimetric Assay Kit (Complexing Method)	E-BC-K775-M		✓
Human HIF-1α(Hypoxia Inducible Factor 1 Alpha) ELISA Kit	E-EL-H6066		✓
Mitochondrial Complex I (NADH-CoQ Reductase) Activity Assay Kit	E-BC-K149-M		✓
Mitochondrial Complex II Activity Assay Kit	E-BC-K150-M		✓
Mitochondrial Complex III (Coenzyme Q-Cytochrome C Reductase) Activity Assay Kit	E-BC-K151-M		✓
Mitochondrial Complex IV (Cytochrome C Oxidase) Activity Assay Kit	E-BC-K152-M		✓

For more cuproptosis-related products, please visit www.elabscience.com or contact your local distributor.

Instrument Abbreviation Key*	
Abbreviation	Full Name
FMPR	Fluorescence Microplate Reader
MR	Microplate Reader

▶Product Citations (Partial)

Citation	Journal	Product Name
Hu H, Hua S, Lu F, et al. Mucous Permeable Nanoparticle for Inducing Cuproptosis-Like Death In Broad-Spectrum Bacteria for Nebulized Treatment of Acute Pneumonia. *Adv Sci* (Weinh). 2025;12(15):e2408580. doi:10.1002/advs.202408580	*Advanced Science*	Cell Copper (Cu^{2+}) Colorimetric Assay Kit (Complexing Method) (E-BC-K775-M)
Wang H, Guo M, Ren B, et al. Circadian control of hepatic ischemia/reperfusion injury via HSD17B13-mediated autophagy in hepatocytes. *J Hepatol*. 2025;83(3):750-767. doi:10.1016/j.jhep.2025.02.029	*Journal of Hepatology*	Total Glutathione (T-GSH)/ Oxidized Glutathione (GSSG) Colorimetric Assay Kit (E-BC-K097-M)
Zhang N, Sun L, Zhou S, et al. Cholangiocarcinoma PDHA1 succinylation suppresses macrophage antigen presentation via alpha-ketoglutaric acid accumulation. *Nat Commun*. 2025;16(1):3177. Published 2025 Apr 3. doi:10.1038/s41467-025-58429-7	*Nature Communications*	α-Ketoglutarate (α-KG) Fluorometric Assay Kit (E-BC-F047)

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