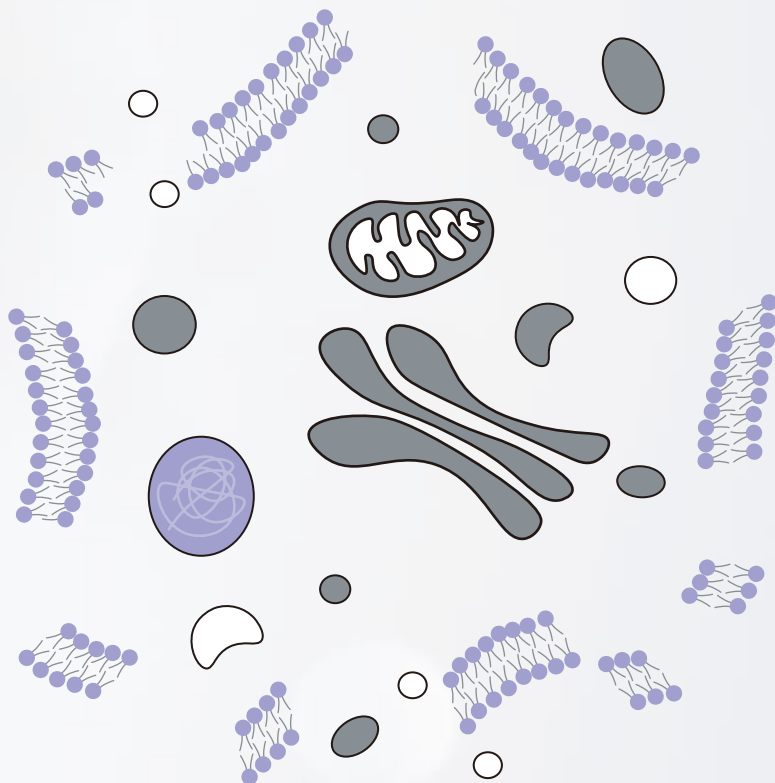


# 细胞焦亡 Pyroptosis



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## 细胞焦亡

细胞焦亡 (pyroptosis) 是一种特殊的炎性细胞程序性死亡方式，是机体中重要的先天性防御机制，在拮抗外部病原体 and 感知内源信号中起重要作用。

细胞焦亡与炎症小体 (Inflammasome) 密切相关。当细胞发生焦亡时，主要表现出细胞核固缩、染色质断裂、细胞胀大形成突出泡等特征，最终导致细胞膜破裂，使得细胞内含物释放并引起炎症。细胞焦亡有两条主要途径，分别是依赖 Caspase-1 的经典途径和依赖 Caspase-4/5/11 的非经典途径。

当外来病原体和内源性物质感染宿主细胞时，模式识别受体 (Pattern Recognition Receptor, PRR)，主要是 Toll 样受体 (Toll-like Receptor, TLR) 会先识别并结合病原相关分子 (Pathogen-Associated Molecular Pattern, PAMP) 和损伤相关分子 (Damage-Associated Molecular Pattern, DAMP)，然后激活 NF- $\kappa$ B 通路，表达 NLRP3、IL-1 $\beta$  和 IL-18 的前体蛋白 (图 1)。

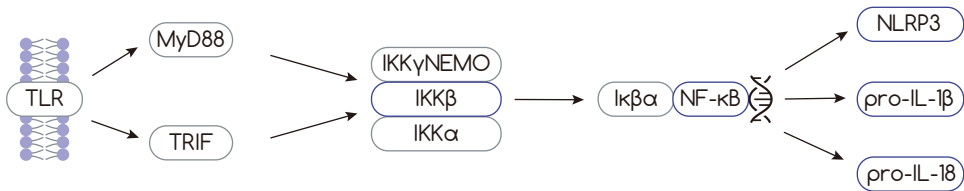


图 1：TLR 激活下游引起 NLRP3 表达增加

相比于细胞凋亡，细胞焦亡发生的更快，并伴随着大量促炎症因子的释放。pro-Caspase-1 可以与 NLRP1、NLRP3 通过接头蛋白 ASC，形成一个高分子复合体，即炎症小体。

炎症小体组装后，pro-Caspase-1 被切割为活性片段，IL-1 $\beta$  和 IL-18 前体被活化的 Caspase-1 切割，变为成熟体。同时，Gasdermin-D (GSDMD) 被 Caspase-1 切割后，释放出 N 端结构域，然后对细胞膜进行打孔，促进细胞焦亡 (图 2)。细胞膜破裂后，炎症因子和趋化因子被释放到膜外，招募更多的炎性细胞引起炎症反应。

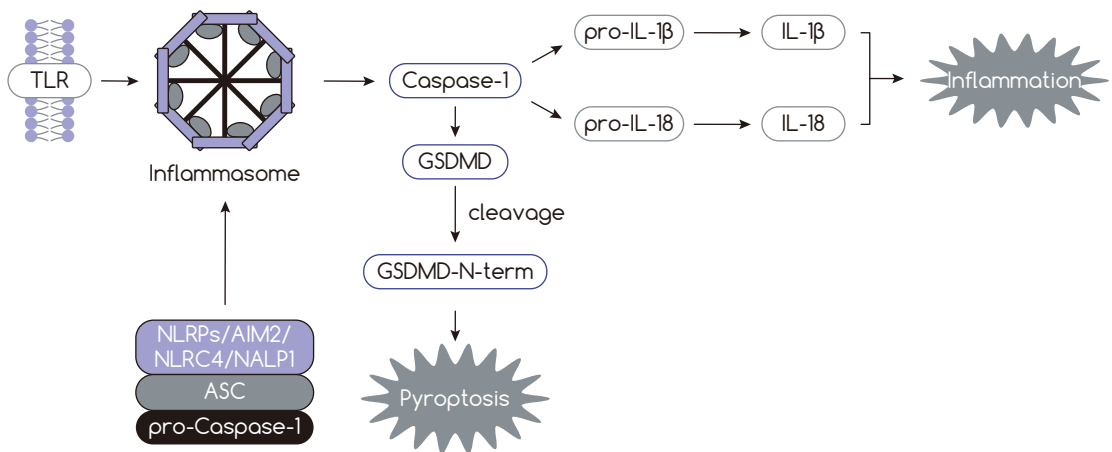


图 2：炎症小体的组装引发焦亡和炎症

脂多糖 (Lipopolysaccharide, LPS) 也可以激活 Caspase-4/5/11 的非经典途径来诱导细胞焦亡 (图3)。在机制上, LPS 可以不通过受体直接进入胞质, 来活化 Caspase-4/5/11 切割 GSDMD, 产生效应, 其中, Caspase-11 仅存在于小鼠中, 与人 Caspase-4/5 同源 (图3)。

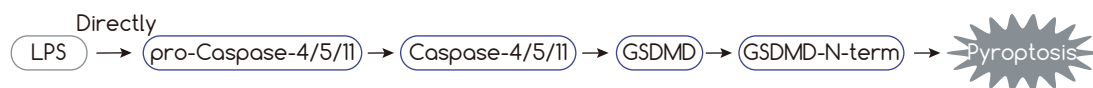


图3：细胞焦亡非经典途径

综上, 为了判断所诱发的细胞死亡方式是否为细胞焦亡, 需要检测如下的指标：

1. GSDMD 的切割情况；
2. Caspase 的激活水平；
3. IL-1 $\beta$  和 IL-18 前体的切割和成熟体释放程度；
4. 染色质完整性的检测。

细胞焦亡·相关靶标				
靶标	产品货号	产品名称	反应种属	应用
	R23722	Caspase 1 Rabbit mAb	Human	WB,IP
	381016	Caspase 1 Rabbit pAb	Human,Rat	WB,IHC-P
	341030	Cleaved-Caspase 1 Rabbit pAb	Human,Mouse	WB,ICC/IF,IHC-F,IHC-P,ELISA
	347416	Cleaved-Caspase 4/5 p20 Rabbit pAb	Human	WB,ELISA
	R381294	Caspase 5 Rabbit mAb	Human	WB,IHC-P,ICC/IF,IP
	R23724	Caspase 11 Rabbit mAb	Human,Mouse,Rat	WB,IP
	R24514	GSDMD Rabbit mAb	Human	WB
	R24674	IKK alpha Rabbit mAb	Human,Mouse,Rat	WB
	IKK	381216	IKK alpha/beta Rabbit pAb	Human,Mouse,Rat
R24676		IKK beta Rabbit mAb	Human,Mouse,Rat	WB,ICC/IF
	511369	IL 1 beta Rabbit pAb	Human,Mouse,Rat	WB
	516288	IL 1 beta Rabbit pAb	Human,Mouse,Rat	WB,IHC-P,ICC/IF
	R24693	IL 18 Rabbit mAb	Human	WB,IHC-P
	516737	IL 18 Rabbit pAb	Human,Mouse,Rat	WB,ICC/IF
NF-κB	R25145	NF-κB p100 Rabbit mAb	Human,Mouse,Rat	WB,ICC/IF,IP
	250060	NF-κB p65 (3D2) Mouse mAb	Human,Mouse,Rat	WB,IHC-F,IHC-P,ICC/IF,IP
	R25149	NF-κB p65 Rabbit mAb	Human,Mouse	WB,IHC-F,IHC-P,ICC/IF,IP
	R23319	NLRP3 Rabbit mAb	Human,Mouse,Rat	WB
	381207	NLRP3 Rabbit pAb	Human,Mouse,Rat	WB,IHC-P,ICC/IF
	R23333	Toll Like Receptor 2 Rabbit mAb	Mouse	WB,IHC-F,IHC-P,ICC/IF
	617066	Toll Like Receptor 4 Rabbit pAb	Human	WB,FC
	R381797	Toll Like Receptor 7 Rabbit mAb	Human	WB,IHC-P

## Toll Like Receptor 4 Rabbit pAb

#617066 / Reactivity: Human / Application: WB,FC

PMID: — / IF=9.41 / Human / WB / MATERIALS & DESIGN

## NF-KB p65 Rabbit mAb

#R25149 / Reactivity: Human,Mouse / Application: WB,IHC-F,IHC-P,ICC/IF,IP

PMID: 33913537 / IF=6.99 / Human / WB / JOURNAL OF PERIODONTOLOGY

## Phospho-NF-KB p65 (Ser536) Rabbit pAb

#310013 / Reactivity: Human,Mouse,Rat / Application: WB,IHC-P,ICC/IF

PMID: 35691153 / IF=7.41 / Human,Mouse / WB / BIOMEDICINE & PHARMACOTHERAPY

PMID: 36386139 / IF=5.99 / Mouse / WB / Frontiers in Pharmacology

PMID: 36577159 / IF=5.7 / Mouse / WB / INTERNATIONAL IMMUNOPHARMACOLOGY

## IL 1 beta Rabbit pAb

#516288 / Reactivity: Human,Mouse,Rat / Application: WB,IHC-P,ICC/IF

PMID: 34687286 / IF=16.8 / Mouse / IHC / Advanced Science

PMID: 35527135 / IF=7.32 / Mouse / WB / BMaterials Science & Engineering C-Materials for Biological Applications

PMID: 34722327 / IF=5.29 / Mouse / IF / Frontiers in Cellular and Infection Microbiology

## IL 18 Rabbit mAb

#R24693 / Reactivity: Human / Application: WB,IHC-P

PMID: 34022569 / IF=7.96 / Duck / WB / SCIENCE OF THE TOTAL ENVIRONMENT

## NLRP3 Rabbit pAb

#381207 / Reactivity: Human,Mouse,Rat / Application: WB,IHC-P,ICC/IF

PMID: 36497096 / IF=7.66 / Rat, Human / WB, IF / Cells

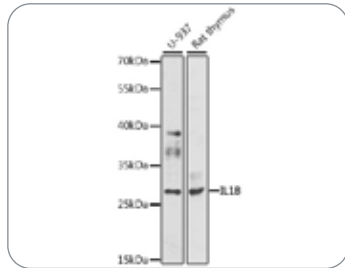
PMID: 34413926 / IF=6.54 / Human / WB / Oxidative Medicine and Cellular Longevity

PMID: 34022569 / IF=7.96 / Duck / WB / SCIENCE OF THE TOTAL ENVIRONMENT



#511369

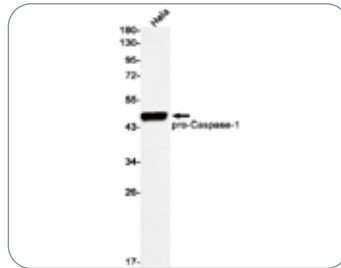
### IL-1 beta Rabbit pAb



Western blot analysis of IL-1 beta in various cell lines lysates using IL-1B antibody.

#R23722

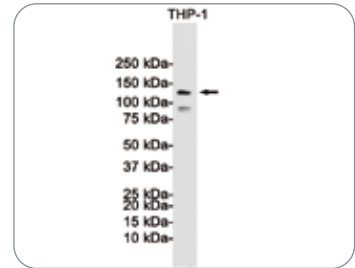
### Caspase 1 Rabbit mAb



Western blot analysis of Caspase1 in HeLa lysates using Caspase 1 antibody.

#R23319

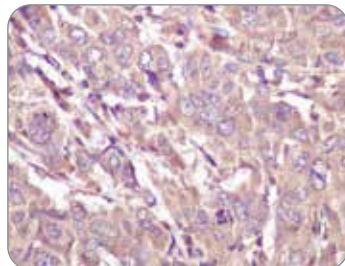
### NLRP3 Rabbit mAb



Western blot analysis of NLRP3 in THP-1 lysates using NLRP3 antibody.

#R381294

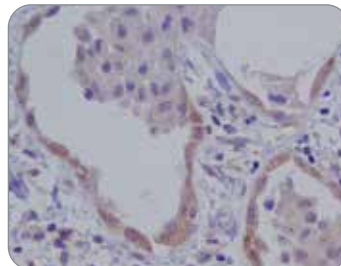
### Caspase 5 Rabbit mAb



Immunohistochemistry analysis of paraffin-embedded Human breast cancer using Caspase 5 antibody. High-pressure and temperature Sodium Citrate pH 6.0 was used for antigen retrieval.

#381207

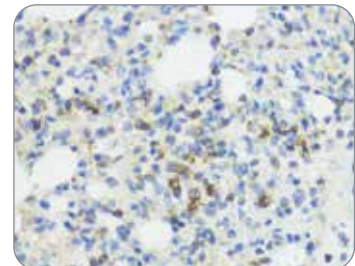
### NLRP3 Rabbit pAb



Immunohistochemistry analysis of paraffin-embedded Human lung carcinoma using NLRP3 antibody. High-pressure and temperature Sodium Citrate pH 6.0 was used for antigen retrieval.

#516288

### IL-1 beta Rabbit pAb



Immunohistochemistry analysis of paraffin-embedded rat lung using IL-1B antibody. High-pressure and temperature Sodium Citrate pH 6.0 was used for antigen retrieval.