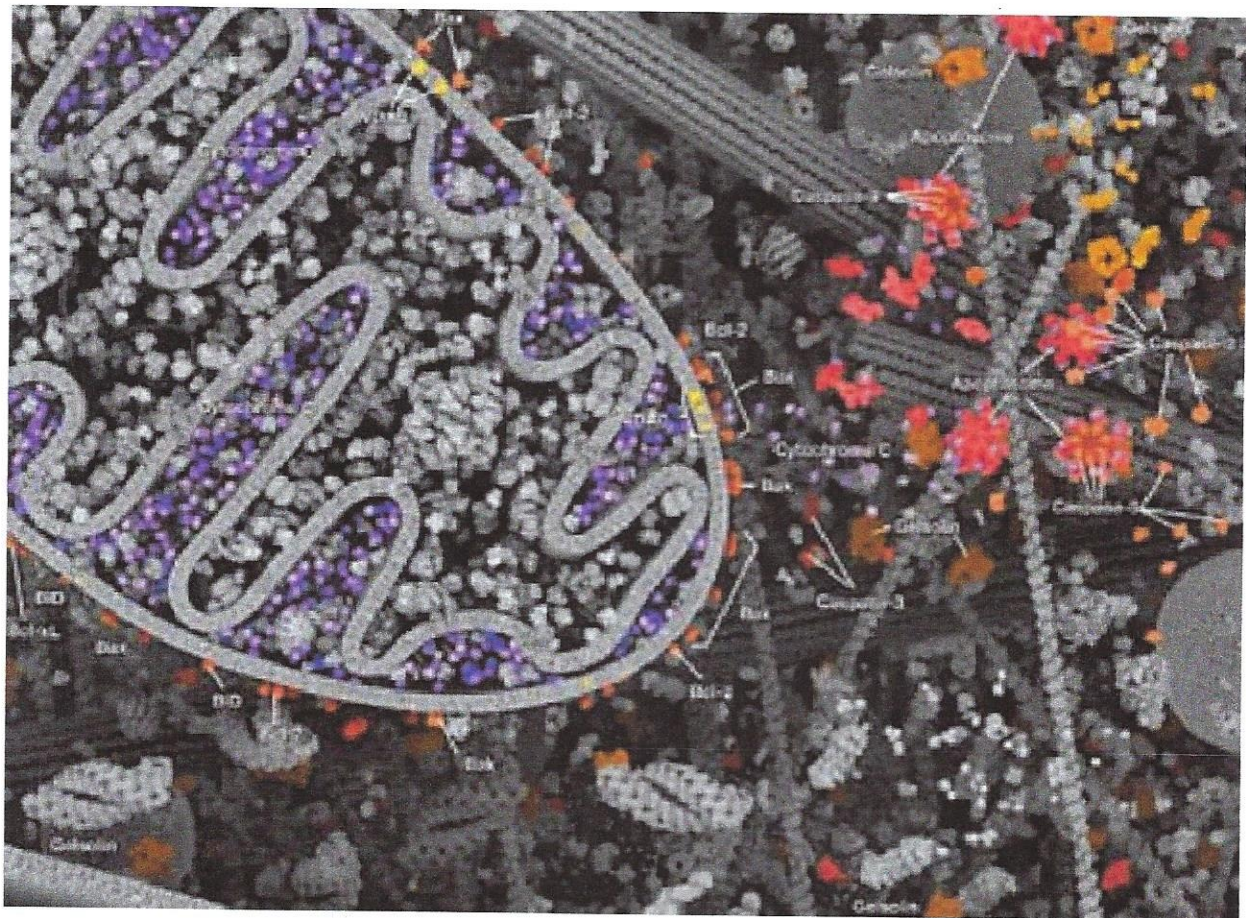




BioFoundations

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A Natural Approach to Human Health



Facilitating and Enhancing Normal Apoptosis with Natural Substances



"Life and death are one thread, the same line viewed from different sides."

Lao Tzu (ancient Chinese philosopher)

In terms of the body and human physiology, life cannot exist without cellular death. There are a number of ways in which cells of the body die. One important form of cell death is programmed cell death, commonly called apoptosis. Apoptosis is a word derived from the Greek language and translates as "falling off," as in leaves from a tree.

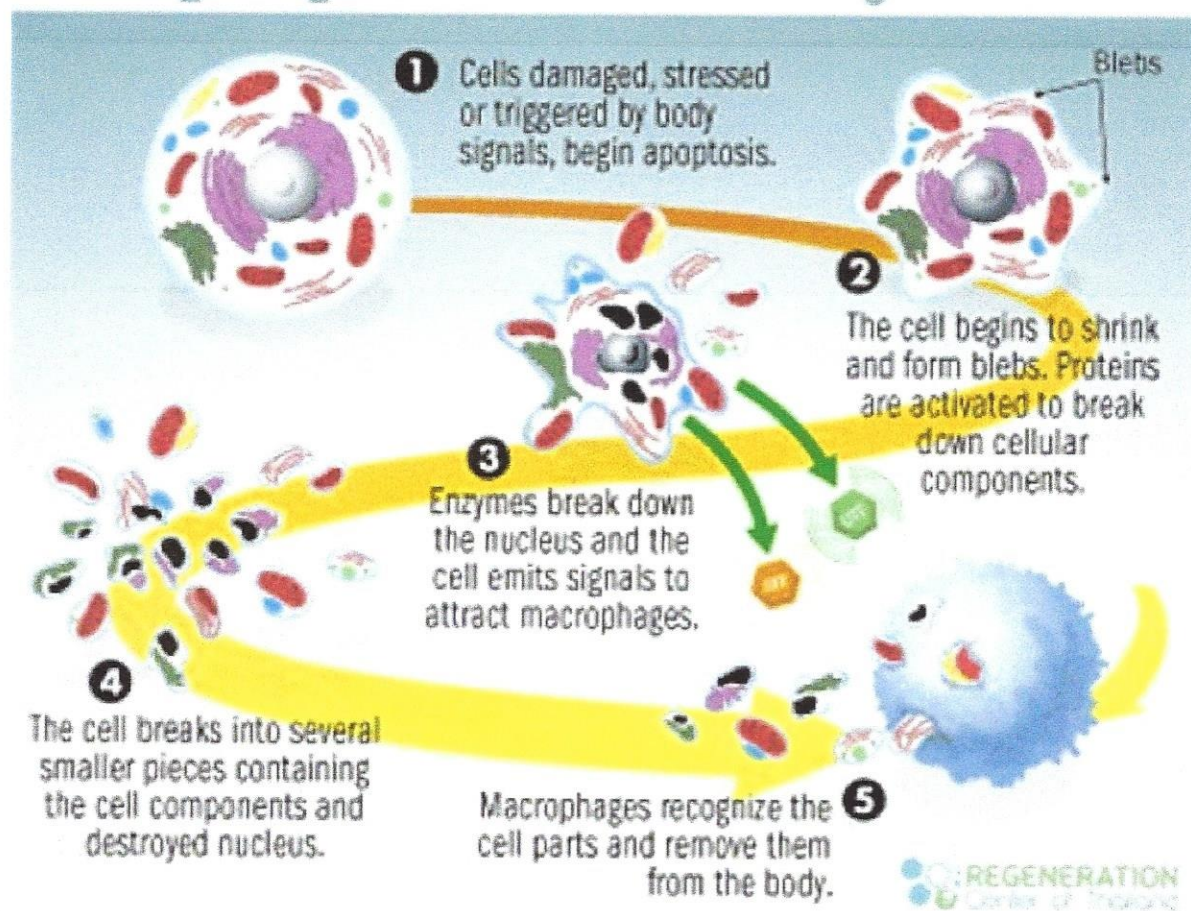
Apoptosis occurs under normal physiological conditions in which the cell is an active participant in its own demise through "cellular suicide". Apoptosis is the mechanism for disposing of dead cells so that they do not accumulate in the body. 1 In the average human adult, between 50 and 70 billion cells die each day due to apoptosis. The average human adult has more than 13 trillion cells (10^{13}), of which at most only 70 billion (7.0×10^{10}) die per day. That is about 5 out of every 1,000 cells (0.5%) die each day due to apoptosis. 2

The apoptosis cycle is well regulated where dying cells shrink and condense and the cytoskeleton collapses, the nuclear envelope disassembles, and the nuclear DNA breaks up into fragments, where the releasing small membrane-bound apoptotic bodies are phagocytosed by other cells. ~~With apoptosis, the intracellular constituents of the cell are not released into the extracellular environment where they might have deleterious effects on neighboring cells.~~

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Apoptosis Cycle

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Source: [Regeneration Center of Thailand](#)

Apoptosis should be contrasted with necrosis, where cells die in response to serious physical tissue damage or chemical insult (e.g., hypoxia, hyperthermia, ischemia). With necrosis, cells swell and burst, releasing their intracellular contents into the extracellular environment, which can damage surrounding cells and frequently cause inflammation.

Functions of Normal Apoptosis

Apoptosis is a normal physiological form of cell death that plays a key

role both in the maintenance of adult tissues and in embryonic development. The function of apoptosis in adults includes:

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- **balancing cell proliferation and maintaining constant cell numbers in tissues undergoing cell turnover**
- **induction and maintenance of immune tolerance**
- **serves in the development of the nervous system**
- **a defense mechanism by which damaged and potentially dangerous cells can be eliminated for the good of the organism as a whole, as in the case of:**
 - **cells infected with viruses**
 - **cells of the immune system**
 - **cells with DNA damage**
 - **cancer cells**

Initiation of Apoptosis

Apoptosis can be initiated through one of two pathways, either through the intrinsic pathway or the extrinsic pathway.

In the intrinsic pathway, apoptosis occurs because the cell senses some form of stress, while in the extrinsic pathway, apoptosis occurs because of signals from other cells.

Probably the most important inducer of apoptosis is damage to the DNA where cells are eliminated that carry potentially harmful mutations, especially mutations that might lead to the development of cancer.

Defective Apoptotic Processes

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The apoptotic process, what is termed "normal apoptosis", can become defective and which has been implicated in a wide variety of diseases.

Dysfunctional apoptosis can arise in two forms, either an inhibition of apoptosis, where there is "too little" apoptosis or excessive or hyper-active apoptosis, where there is "too much" apoptosis.

Functional apoptosis is what naturally occurs in the healthy human body and is known as normal apoptosis.

Inhibition of Apoptosis

Apoptosis can be inhibited in the body where apoptosis slows down its activity or is turned off. In this case, an accumulation of dead cells occur in the body and/or cells may undergo uncontrolled reproduction.

Scientific studies have been published by researchers that have identified a number of chemical toxins that inhibit or turn off apoptosis. Some of these chemical toxins include:

- **Aflatoxins** (Poisonous and cancer-causing chemicals that are produced by certain molds (*Aspergillus flavus* and *Aspergillus parasiticus*) which grow in soil, decaying vegetation, hay, and grains). [3](#) [4](#) [5](#) [6](#)
- **Heavy metals** [7](#) [8](#) [9](#) [10](#)

- **Pesticides/herbicides** 11
- **UV light** 12 13

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Inhibition of apoptosis can result in a number of disease, which include:

- **Cancer**
- **Chronic inflammatory conditions**
- **Autoimmune diseases**
- **Canale-Smith Syndrome (Autoimmune lymphoproliferative syndrome (ALPS))**
- **Viral infections**

Cancer is the most common disease process that occurs with an inhibited apoptotic process. Under normal circumstances damaged cells will undergo apoptosis, but in the case of cancer, cellular mutations may have occurred that prevent cells from undergoing apoptosis. In these cases there is no check on the cellular proliferation and consequently the disease can progress to the formation of tumors.

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Excessive or hyperactive apoptosis

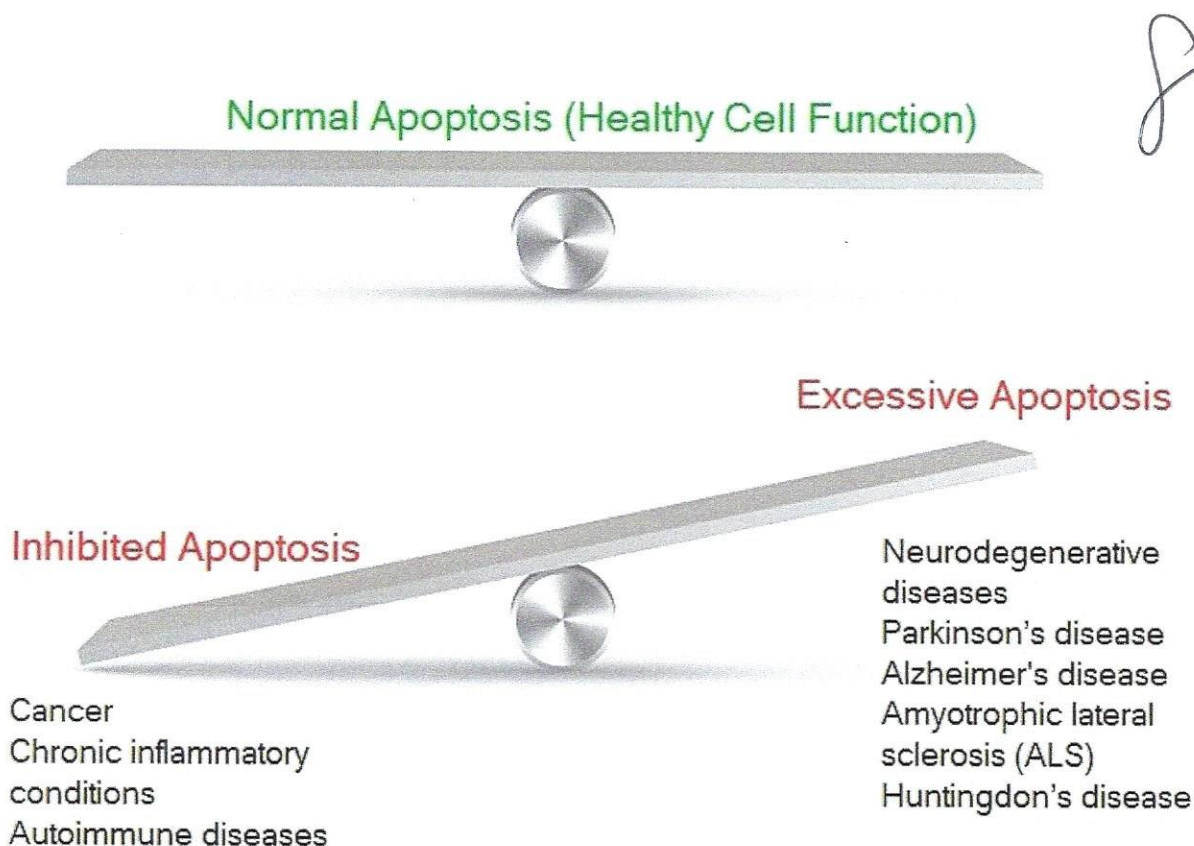
Excessive apoptosis can be very damaging to the body since it kills and removes non-damaged cells and accelerates the aging process. Oxidative stress (free radicals) is a cause of excessive apoptosis.

Excessive apoptosis can lead to a number of disease states, including:

- **Autoimmune diabetes mellitus (excessive apoptosis of islet cells of the pancreas) 15**
- **Hematologic diseases**
- **Tissue damage**
- **Atrophy**
- **Neurodegenerative diseases:**
 - **Parkinson's disease**
 - **Alzheimer's disease**
 - **Amyotrophic lateral sclerosis (ALS)**
 - **Huntingdon's disease**

There a few natural substances that counteract excessive apoptosis.
These include:

- **Nicotinamide (A form of Niacin or Vitamin B3)**
 - The vitamin nicotinamide can protect against oxidative stress-induced apoptosis in the brain when used as a precursor for nicotinamide adenine dinucleotide (NAD+). 16
- **Co-Enzyme Q10 (CoQ10)**
 - CoQ10 is used as a generic anti-apoptotic compound and have found that its ability to protect against apoptosis varies depending on both cell type and mode of cell death induction. 17



Nutrients that Enhance and Facilitate the Function of Normal Apoptosis

The objective in the management and regulation of apoptosis is to maintain what is termed "normal apoptosis", which essentially is a form of apoptosis that occurs under normal physiological conditions and where there is no excessive apoptosis and no inadequate or inhibited apoptosis.

Researchers have identified a number of natural substances that can be consumed in order to enhance and facilitate normal apoptosis.

The Table below is a detailed list of nutrients that promote, enhance and restore normal apoptosis:

Nutrients that Promote or Restore Apoptosis



CATEGORY	NUTRIENT	REFERENCE
Carotenoids		
	Lycopene	1
Foods		
	Propolis	2 3
Herbs		
	Red clover isoflavones	4
	Rosemary (carnosol)	5 6
	Sarsaparilla (<i>Smilax glabra</i>)	7
	Saffron	8
	Saw Palmetto	9
Lipids		
	Docosahexaenoic Acid (DHA)	10
	Perillyl Alcohol (a constituent of Lavender and Tart Cherry)	11
Minerals		
	Selenium	12
Pectins		
	Modified Citrus Pectin	13
CATEGORY	NUTRIENT	REFERENCE

CATEGORY	NUTRIENT	REFERENCE
Polyphenols		
	Coffee extract	14
	Curcumin	15 16 17
	Amla or Indian Gooseberry (<i>Emblica officinalis</i>)	18
	Green tea extract (EGCG)140-144	19 20 21 22
	Phenyl isothiocyanate (PEITC) from cruciferous vegetables	23
	Pine bark extract (Enzogenol)	24 25
	Quercetin	26 27
	Ellagic Acid	28
Porphyrins		
	Chlorophyllin	29 30
Prebiotics		
	Prebiotics (fermentable fiber, which produces short-chain fatty acid butyrate)	31
Probiotics		
	<i>Lactobacillus salivarius</i>	32
Sulfuric Compounds		
	Allicin	33
CATEGORY	NUTRIENT	REFERENCE

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CATEGORY	NUTRIENT	REFERENCE
Vitamins		
	Vitamin C	34
	Vitamin K	35
CATEGORY	NUTRIENT	REFERENCE

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