

Format:

Abstract ▾

Send to ▾

Full text links

[BenthamScience](#)  
Full-Text Article
[Curr Pharm Des.](#) 2014;20(35):5510-26.

## Metabolic reprogramming of human cells in response to oxidative stress: implications in the pathophysiology and therapy of mitochondrial diseases.

Wu YT, Wu SB, Wei YH<sup>1</sup>.

### Author information

- 1 Department of Biochemistry and Molecular Biology, School of Life Sciences, National Yang-Ming University, Taipei, Taiwan 112. joeman@ym.edu.tw.

### Abstract

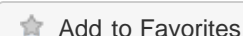
Mitochondria are the organelles producing most of the energy and play important roles in a variety of biochemical functions in human cells. Mitochondrial defects can cause ATP deficiency and overproduction of reactive oxygen species, which are the major hallmarks of mitochondrial diseases. Abundant evidence has suggested that mitochondrial dysfunction-elicited oxidative stress can play an important role in the pathogenesis and progression of mitochondrial diseases. Mitochondria can respond to energy deficiency by the retrograde signaling to trigger a number of molecular events to help the human cells to cope with physiological or environmental changes. In this article, we first describe oxidative stress-induced cellular responses including metabolic adaptation, compensatory increase of mitochondrial biogenesis, upregulation of antioxidant enzymes, and alteration of protein acetylation in human cells with mitochondrial dysfunction. In this regard, we review recent findings to elucidate the mechanisms by which human cells motivate their mitochondria and the antioxidant defense system to respond to energy deficiency and oxidative stress, which contribute to the adaptive metabolic reprogramming in mitochondrial diseases. In addition, we emphasize the critical role of the activation of AMPK, Sirt1 and Sirt3 in the metabolic adaptation of human cells harboring mitochondrial DNA mutations. Recent studies have revealed that AMPK and sirtuins-mediated signaling pathways are involved in metabolic reprogramming, which is effected by upregulation of antioxidant defense system and mitochondrial protein acetylation, in human cells with mitochondrial dysfunction. Finally, we discuss several potential modulators of bioenergetic function such as coenzyme Q10, mitochondria-targeting antioxidants, resveratrol, and L-carnitine based on recent findings from studies on human cells and animal models of mitochondrial diseases. Elucidation of the signaling pathway of this adaptive response to oxidative stress triggered by mitochondrial dysfunction may enable us to gain a deeper insight into the communication between mitochondria and the nucleus and guide us to develop novel therapeutic agents for effective treatment of mitochondrial diseases.

PMID: 24606797

[Indexed for MEDLINE]



Save items



Similar articles

[Mitochondrial biogenesis: pharmac](#) [Curr Pharm Des. 2014]

[Review](#) Roles of sirtuins in the regulation [Free Radic Res. 2014]

[Review](#) Role of AMPK-me [Biochim Biophys Acta. 2014]

[Review](#) Oxidative stress, mitochondria [J Neurol Sci. 2005]

[Review](#) Mitochondria, metabolic disturbances [J Neurol Sci. 2007]

See reviews...

See all...

Cited by 6 PubMed Central articles

[Bisdemethoxycurcumin exerts pro-apoptotic](#) [Oncotarget. 2016]

[Oxidative stress induces transient](#) [J Cell Mol Med. 2016]

[Redox homeostasis protects mitochondria thr](#) [Sci Rep. 2016]

See all...

Related information

Articles frequently viewed together

MedGen

Cited in PMC



Publication types, MeSH terms, Substances +

LinkOut - more resources +

## PubMed Commons

0 comments

[PubMed Commons home](#)

[How to join PubMed Commons](#)

## Recent Activity ▲

[Turn Off](#) [Clear](#)

[Metabolic reprogramming of human cells in respo](#) PubMed

[Mitochondrial biogenesis: pharmacological](#) PubMed

[Using chemical biology to assess and modulate](#)

[Using chemical biology to assess and modulate](#) PubMed

[Cited In for PubMed \(Select 20481466\) \(67\)](#) PubMed

[See more...](#)

You are here: [NCBI](#) > [Literature](#) > [PubMed](#)

[Support Center](#)

### GETTING STARTED

[NCBI Education](#)  
[NCBI Help Manual](#)  
[NCBI Handbook](#)  
[Training & Tutorials](#)  
[Submit Data](#)

### RESOURCES

[Chemicals & Bioassays](#)  
[Data & Software](#)  
[DNA & RNA](#)  
[Domains & Structures](#)  
[Genes & Expression](#)  
[Genetics & Medicine](#)  
[Genomes & Maps](#)  
[Homology](#)  
[Literature](#)  
[Proteins](#)  
[Sequence Analysis](#)  
[Taxonomy](#)  
[Variation](#)

### POPULAR

[PubMed](#)  
[Bookshelf](#)  
[PubMed Central](#)  
[PubMed Health](#)  
[BLAST](#)  
[Nucleotide](#)  
[Genome](#)  
[SNP](#)  
[Gene](#)  
[Protein](#)  
[PubChem](#)

### FEATURED

[Genetic Testing Registry](#)  
[PubMed Health](#)  
[GenBank](#)  
[Reference Sequences](#)  
[Gene Expression Omnibus](#)  
[Map Viewer](#)  
[Human Genome](#)  
[Mouse Genome](#)  
[Influenza Virus](#)  
[Primer-BLAST](#)  
[Sequence Read Archive](#)

### NCBI INFORMATION

[About NCBI](#)  
[Research at NCBI](#)  
[NCBI News & Blog](#)  
[NCBI FTP Site](#)  
[NCBI on Facebook](#)  
[NCBI on Twitter](#)  
[NCBI on YouTube](#)

National Center for Biotechnology Information, U.S. National Library of Medicine  
 8600 Rockville Pike, Bethesda MD, 20894 USA  
[Policies and Guidelines](#) | [Contact](#)

