

БИБЛИОГРАФИЯ

Глава 1

Althoff T., et al. Arrangement of electron transport chain components in bovine mitochondrial supercomplex I1III2IV1. *EMBO J.* 2011 Sep 9; 30(22):4652–64. doi:10.1038/emboj.2011.324.

Ames B. N., Shigenaga M. K., Hagen T. M. Oxidants, antioxidants, and the degenerative diseases of aging. *Proc Natl Acad Sci USA.* 1993 Sep 1; 90(17):7915–22.

Ames B. N., Shigenaga M. K., Hagen T. M. Mitochondrial decay in aging. *Biochim Biophys Acta.* 1995 May 24;1271(1):165–70. doi:10.1016/0925-4439(95)00024-X

Aw T. Y., Jones D. P. Nutrient supply and mitochondrial function. *Annu Rev Nutr.* 1989 Jul; 9:229–51. doi:10.1146/annurev.nu.09.070189.001305.

Bagh M. B., et al. Age-related oxidative decline of mitochondrial functions in rat brain is prevented by long term oral antioxidant supplementation. *Biogerontology.* 2010 Sep 21; 12(2):119–31. doi:10.1007/s10522-010-9301-8.

Blackstone N. W. Why did eukaryotes evolve only once? Genetic and energetic aspects of conflict and conflict mediation. *Philos Trans R Soc Lond B Biol Sci.* 2013 Jul 19; 368(1622):20120266. doi:10.1098/rstb.2012.0266.

Brookes P. S., et al. Calcium, ATP, and ROS: a mitochondrial love-hate triangle. *Am J Physiol Cell Physiol.* 2004 Oct; 287(4):C817–33. doi:10.1152/ajpcell.00139.2004.

Bua E. A., et al. Mitochondrial abnormalities are more frequent in muscles undergoing sarcopenia. *J Appl Physiol* (1985). 2002 Jun; 92(6):2617–24. doi:10.1152/jappphysiol.01102.2001.

Buist R. Elevated xenobiotics, lactate and pyruvate in C.F.S. patients. *J Orthomol Med*. 1989; 4:170–2.

Cavalli L. R., et al. Mutagenesis, tumorigenicity, and apoptosis: are the mitochondria involved? *Mutat Res*. 1998; 398:19–26.

Chautan M., et al. Interdigital cell death can occur through a necrotic and caspase-independent pathway. *Curr Biol*. 1999 Sep 9; 9(17):967–70. doi:10.1016/S0960-9822(99)80425-4.

Chiang S. C., et al. Mitochondrial protein-linked DNA breaks perturb mitochondrial gene transcription and trigger free radical-induced DNA damage. *Sci Adv*. 2017 Apr 28; 3(4): e1602506. doi:10.1126/sciadv.1602506.

Chinnery P. F., Hudson G. Mitochondrial genetics. *Br Med Bull*. 2013; 106:135–59. Epub 2013 May 22. doi:10.1093/bmb/ldt017.

Cohen B. H., Gold D. R. Mitochondrial cytopathy in adults: what we know so far. *Cleve Clin J Med*. 2001 Jul; 68(7): 625–26, 629–42.

Conley K. E., et al. Ageing, muscle properties and maximal O₂ uptake rate in humans. *J Physiol*. 2000 Jul 1; 526 (Pt 1): 211–17. doi:10.1111/j.1469-7793.2000.00211.x.

Cooper G. M. The cell: a molecular approach. 2nd ed. Sunderland, MA: Sinauer Associates; 2000.

Copeland W. C., Longley M. J. Mitochondrial genome maintenance in health and disease. *DNA Repair (Amst)*. 2014 Jul; 19:190–8. Epub Apr 26. doi:10.1016/j.dnarep.2014.03.010.

Corral-Debrinski M., et al. Association of mitochondrial DNA damage with aging and coronary atherosclerotic heart disease. *Mutat Res*. 1992 Sep; 275(3–6):169–80.

Croteau D. L., Bohr V. A. Repair of oxidative damage to nuclear and mitochondrial DNA in mammalian cells. *J Biol Chem*. 1997 Oct 10; 272:25409–12. doi:10.1074/jbc.272.41.25409.

Einat H., Yuan P., Manji H. K. Increased anxiety-like behaviors and mitochondrial dysfunction in mice with targeted mutation of the Bcl-2 gene:

further support for the involvement of mitochondrial function in anxiety disorders. *Behav Brain Res.* 2005 Aug 10; 165:172–80. doi:10.1016/j.bbr.2005.06.012.

Fattal O., et al. Review of the literature on major mental disorders in adult patients with mitochondrial diseases. *Psychosomatics.* 2006 Jan-Feb; 47(1):1–7. doi:10.1176/appi.psy.47.1.1.

Fontaine E., et al. Regulation of the permeability transition pore in skeletal muscle mitochondria. *J Biol Chem.* 1998 May 15; 273:12662–8. doi:10.1074/jbc.273.20.12662.

Fosslien E. Mitochondrial medicine — molecular pathology of defective oxidative phosphorylation. *Ann Clin Lab Sci.* 2001 Jan; 31(1):25–67.

Fulle S., et al. Specific oxidative alterations in vastus lateralis muscle of patients with the diagnosis of chronic fatigue syndrome. *Free Radic Biol Med.* 2000; 29:1252–9.

Garrett R. H., Grisham C. M. *Biochemistry.* Boston: Brooks/Cole; 2010.

Giles R. E., et al. Maternal inheritance of human mitochondrial DNA. *Proc Natl Acad Sci USA.* 1980 Nov; 77(11):6715–9.

Gill T., Levine A. D. Mitochondrial derived hydrogen peroxide selectively enhances T cell receptor-initiated signal transduction. *J Biol Chem.* 2013 Sep 6; 288(36):26246–55. Epub 2013 Jul 23. doi:10.1074/jbc.M113.476895.

Gray M. W., Burger G., Lang B. F. Mitochondrial evolution. *Science.* 1999 Mar 5; 283(5407):1476–81.

Hagen T. M., Wehr C. M., Ames B. N. Mitochondrial decay in aging. Reversal through supplementation of acetyl-L-carnitine and N-tert-butyl-alpha-phenyl-nitrone. *Ann N Y Acad Sci.* 1998 Nov 20; 854:214–23.

Hengartner M. O. The biochemistry of apoptosis. *Nature.* 2000; 407(6805):770–6. doi:10.1038 /35037710.

Hirst J. Mitochondrial complex I. *Annu Rev Biochem.* 2013; 82:551–75. Epub 2013 Mar 18. doi:10.1146/annurev-biochem-070511-103700.

Ip SW, et al. Capsaicin induces apoptosis in SCC-4 human tongue cancer cells through mitochondria-dependent and -independent pathways. *Environ Toxicol.* 2012 May; 27(6):332–41. Oct 5. doi:10.1002/tox.20646.

Javadov S., Kuznetsov A. Mitochondrial permeability transition and cell death: the role of cyclophilin d. *Front Physiol.* 2013 Apr 11; 4:76. doi:10.3389/fphys.2013.00076.

Joza N., et al. Essential role of the mitochondrial apoptosis-inducing factor in programmed cell death. *Nature* 2001 Mar 29; 410(6828):549–54. doi:10.1038/35069004.

Karbowski M., Youle R. J. Dynamics of mitochondrial morphology in healthy cells and during apoptosis. *Cell Death Differ.* 2003 Aug; 10(8):870–80. doi:10.1038/sj.cdd.4401260.

Karp, Gerald. Cell and molecular biology. 5th ed. Hoboken, NJ: John Wiley & Sons; 2008.

Koike K. Molecular basis of hepatitis C virus-associated hepatocarcinogenesis: lessons from animal model studies. *Clin Gastroenterol Hepatol.* 2005 Oct; 3(10 Suppl 2):S132–S135. doi:10.1016/S1542-3565(05)00700-7.

Kopsidas G., et al. An age-associated correlation between cellular bioenergy decline and mtDNA rearrangements in human skeletal muscle. *Mutat Res.* 1998 Oct 12; 421(1):27–36. doi:10.1016/S0027-5107(98)00150-X.

Ku H. H., Brunk U. T., Sohal R. S. Relationship between mitochondrial superoxide and hydrogen peroxide production and longevity of mammalian species. *Free Radic Biol Med.* 1993 Dec; 15(6):621–7.

Lagouge M., Larsson N. G. The role of mitochondrial DNA mutations and free radicals in disease and ageing. *J Intern Med.* 2013 Jun; 273(6): 529–43. Epub 2013 Mar 7.

Lane, N. Power, sex, suicide: mitochondria and the meaning of life. New York: Oxford University Press; 2005.

Lane N. Bioenergetic constraints on the evolution of complex life. *Cold Spring Harb Perspect Biol.* 2014 May 1; 6(5): a015982. doi:10.1101/cshperspect.a015982.

Lang B. F., et al. An ancestral mitochondrial DNA resembling a eubacterial genome in miniature. *Nature.* 1997 May 29; 387(6632):493–7. doi:10.1038/387493a0.

Lanza I. R., Sreekumaran Nair K. Regulation of skeletal muscle mitochondrial function: genes to proteins. *Acta Physiol (Oxf).* 2010 Aug; 199(4): 529–47. doi:10.1111/j.1748-1716.2010.02124.x.

Lapiente-Brun E., et al. Supercomplex assembly determines electron flux in the mitochondrial electron transport chain. *Science*. 2013 Jun 28; 340(6140): 1567–70. doi:10.1126/science.1230381.

Lieber C. S., et al. Model of nonalcoholic steatohepatitis. *Am J Clin Nutr*. 2004 Mar; 79(3):502–9.

Linnane A. W., et al. Mitochondrial DNA mutations as an important contributor to aging and degenerative diseases. *Lancet*. 1989 Mar 25; 1(8639):642–5. doi:10.1016/S0140-6736(89)92145-4.

Linnane A. W., et al. The universality of bioenergetic disease and amelioration with redox therapy. *Biochim Biophys Acta*. 1995 May 24; 1271(1):191–4. doi:10.1016/0925-4439(95)00027-2.

Linnane A. W., Kovalenko S., Gingold E. B. The universality of bioenergetic disease. Age-associated cellular bioenergetic degradation and amelioration therapy. *Ann N Y Acad Sci*. 1998 Nov 20; 854:202–13. doi:10.1111/j.1749-6632.1998.tb09903.x.

Liu J, et al. Delaying brain mitochondrial decay and aging with mitochondrial antioxidants and metabolites. *Ann N Y Acad Sci*. 2002 Apr; 959:133–66. doi:10.1111/j.1749-6632.2002.tb02090.x.

Luft R., et al. A case of severe hypermetabolism of nonthyroid origin with a defect in the maintenance of mitochondrial respiratory control: a correlated clinical, biochemical, and morphological study. *J Clin Invest*. 1962; 41:1776–804.

Manczak M, et al. Mitochondria-targeted antioxidants protect against amyloid-beta toxicity in Alzheimer's disease neurons. *J Alzheimers Dis*. 2010; 20 Suppl 2: S609–S631. doi:10.3233/JAD-2010-100564.

Merry T. L., Ristow M. Do antioxidant supplements interfere with skeletal muscle adaptation to exercise training? *J Physiol*. 2016 Sep 15; 594(18): 5135–47. doi:10.1113/JP270654.

Michikawa Y., et al. Aging-dependent large accumulation of point mutations in the human mtDNA control region for replication. *Science*. 1999 Oct 22; 286(5440): 774–9. doi:10.1126/science.286.5440.774.

Mirisola M. G., Longo V. D. A radical signal activates the epigenetic regulation of longevity. *Cell Metab*. 2013 Jun 4; 17(6):812–3. doi:10.1016/j.cmet.2013.05.015.

Murphy M. P., Smith R. A. Targeting antioxidants to mitochondria by conjugation to lipophilic cations. *Annu Rev Pharmacol Toxicol.* 2007; 47:629–56. doi:10.1146/annurev.pharmtox .47.120505.105110.

Murray R. K., et al. Harper's Illustrated Biochemistry. Hoboken, NJ: Lange Medical Books/ McGraw Hill; 2003.

Newmeyer D. D., Ferguson-Miller S. Mitochondria: releasing power for life and unleashing the machineries of death. *Cell.* 2003 Feb 21; 112(4):481–90. doi:10.1016/S0092-8674(03)00116-8.

Oelkrug R., et al. Brown fat in a protoendothermic mammal fuels eutherian evolution. *Nat Commun.* 2013 Jul 16; 4:2140. doi:10.1038/ncomms3140.

Olsen L. F, Issinger O. G, Guerra B. The Yin and Yang of redox regulation. *Redox Rep.* 2013; 18(6):245–52. doi:10.1179/1351000213Y.0000000059.

Ozawa T. Genetic and functional changes in mitochondria associated with aging. *Physiol Rev.* 1997 Apr 1; 77(2):425–64.

Park J. H., Niermann K. J., Olsen N. Evidence for metabolic abnormalities in the muscles of patients with fibromyalgia. *Curr Rheumatol Rep.* 2000; 2(2):131–40.

Puddu P., et al. Mitochondrial dysfunction as an initiating event in atherogenesis: a plausible hypothesis. *Cardiology.* 2005; 103(3):137–141. doi:10.1159/000083440.

Ricci J. E., et al. Disruption of mitochondrial function during apoptosis is mediated by caspase cleavage of the p75 subunit of complex I of the electron transport chain. *Cell.* 2004 Jun 11; 117(6):773–86. doi:10.1016/j.cell.2004.05.008.

Richter C., et al. Control of apoptosis by the cellular ATP level. 1996 Jan 8; *FEBS Lett* 378(2):107–10. doi:10.1016/0014-5793(95)01431-4.

Samsel A., Seneff S. Glyphosate, pathways to modern diseases II: celiac sprue and gluten intolerance. *Interdiscip Toxicol.* 2013 Dec; 6(4):159–84. doi:10.2478/intox-2013-0026.

Sato M., Sato K. Maternal inheritance of mitochondrial DNA by diverse mechanisms to eliminate paternal mitochondrial DNA. *Biochim Biophys Acta.* 2013 Aug; 1833(8):1979–84. Epub 2013 Mar 21.

Savitha S., et al. Efficacy of levo carnitine and alpha lipoic acid in ameliorating the decline in mitochondrial enzymes during aging. *Clin Nutr.* 2005 Oct; 24(5):794–800. doi:10.1016/j.clnu.2005.04.005.

Schroeder E. A., Raimundo N., Shadel G. S. Epigenetic silencing mediates mitochondria stress-induced longevity. *Cell Metab.* 2013 Jun 4; 17(6):954–64. doi:10.1016/j.cmet.2013.04.003.

Skulachev V. P, Longo V. D. Aging as a mitochondria-mediated atavistic program: can aging be switched off? *Ann NY Acad Sci.* 2005 Dec; 1057:145–64. doi:10.1196/annals.1356.009.

Smith R. A., et al. Mitochondria-targeted antioxidants in the treatment of disease. *Ann NY Acad Sci.* 2008 Dec; 1147:105–11. doi:10.1196/annals.1427.003.

Sohal R. S., Sohal B. H., Orr W. C. Mitochondrial superoxide and hydrogen peroxide generation, protein oxidative damage, and longevity in different species of flies. *Free Radic Biol Med.* 1995 Oct; 19(4):499–504. doi:10.1016/0891-5849(95)00037-X.

Stavrovskaya I. G., Kristal B. S. The powerhouse takes control of the cell: is the mitochondrial permeability transition a viable therapeutic target against neuronal dysfunction and death? *Free Radic Biol Med.* 2005 Mar 15; 38(6):687–97. doi:10.1016/j.freeradbiomed.2004.11.032.

Stork C., Renshaw P. F. Mitochondrial dysfunction in bipolar disorder: evidence from magnetic resonance spectroscopy research. *Mol Psychiatry.* 2005 Oct;10(10):900–19. doi:10.1038/sj.mp.4001711.

Susin S. A., et al. Mitochondria as regulators of apoptosis: doubt no more. *Biochim Biophys Acta.* 1998 Aug 10; 1366(1–2):151–65. doi:10.1016/S0005-2728(98)00110-8.

Tait S. W., Green D. R. Mitochondrial regulation of cell death. *Cold Spring Harb Perspect Biol.* 2013 Sep 1; 5(9):pii:a008706. doi:10.1101/cshperspect.a008706.

Turker M. S. Somatic cell mutations: can they provide a link between aging and cancer? *Mech Aging Dev.* 2000 Aug 15; 117(1–3):1–19. doi:10.1016/S0047-6374(00)00133-0.

Van Raamsdonk J. M. Levels and location are crucial in determining the effect of ROS on lifespan. *Worm.* 2015 Oct–Dec; 4(4):e1094607. doi:10.1080/21624054.2015.1094607.

Vartak R., Porras C. A., Bai Y. Respiratory supercomplexes: structure, function and assembly. *Protein Cell.* 2013 Aug; 4(8):582–90. Epub 2013 Jul 5. doi:10.1007/s13238-013-3032-y.

Wallace D. C. A mitochondrial paradigm of metabolic and degenerative diseases, aging, and cancer: a dawn for evolutionary medicine. *Annu Rev Genet.* 2005; 39:359–407. doi:10.1146/annurev.genet.39.110304.095751.

Wallace D. C. Why do we still have a maternally inherited mitochondrial DNA? Insights from evolutionary medicine. *Annu Rev Biochem.* 2007; 76:781–821. doi:10.1146/annurev.biochem.76.081205.150955.

Wallace D. C. A mitochondrial bioenergetic etiology of disease. *J Clin Invest.* 2013 Apr; 123(4):1405–12. Epub 2013 Apr 1. doi:10.1172/JCI61398.

Wallace D. C., et al. Mitochondrial DNA mutations in human degenerative diseases and aging. *Biochim Biophys Acta.* 1995 May 24; 1271(1):141–51. doi:10.1016/0925-4439(95)00021-U.

Wang C. H., et al. Oxidative stress response elicited by mitochondrial dysfunction: implication in the pathophysiology of aging. *Exp Biol Med (Maywood).* 2013 May; 238(5):450–60. doi:10.1177/1535370213493069.

Wei Y. H., Kao S. H., Lee H. C. Simultaneous increase of mitochondrial DNA deletions and lipid peroxidation in human aging. *Proc NY Acad Sci.* 1996 Jun 15; 786:24–43. doi:10.1111/j.1749-6632.1996.tb39049.x.

West I. C. Radicals and oxidative stress in diabetes. *Diabet Med.* 2000 Mar; 17(3):171–80. doi:10.1046/j.1464-5491.2000.00259.x.

Wolvetang E. J., et al. Mitochondrial respiratory chain inhibitors induce apoptosis. 1994 Feb 14; 339(1–2):40–4. doi:10.1016/0014-5793(94)80380-3.

Wookieepedia. Midi-chlorian [Internet]. [Cited 2011 Dec 27]. <http://starwars.wikia.com/wiki/Midi-chlorian>.

Yunus M. B., Kalyan-Raman U. P., Kalyan-Raman K. Primary fibromyalgia syndrome and myofascial pain syndrome: clinical features and muscle pathology. *Arch Phys Med Rehabil.* 1988 Jun; 69(6):451–4.

Zhang M., Mileyskovskaya E., Dowhan W. Gluing the respiratory chain together: cardiolipin is required for supercomplex formation in the inner mitochondrial/membrane. *J Biol Chem.* 2002 Nov 15; 277(46):43553–6. doi:10.1074/jbc.C200551200.

Глава 2

Hirst J. Mitochondrial complex I. *Annu Rev Biochem.* 2013; 82:551–75. Epub 2013 Mar 18. doi:10.1146/annurev-biochem-070511-103700.

Hwang A. B., Jeong D. E., Lee S. J. Mitochondria and organismal longevity. *Curr Genomics.* 2012 Nov; 13(7):519–32. doi:10.2174/138920212803251427.

Lane, N. Power, sex, suicide: mitochondria and the meaning of life. New York: Oxford University Press; 2005.

Munro D., et al. Low hydrogen peroxide production in mitochondria of the long-lived *Arctica islandica*: underlying mechanisms for slow aging. *Aging Cell.* 2013 Aug; 12(4):584–92. Epub 2013 May 6. doi:10.1111/accel.12082.

Sinatra S. T. The Sinatra solution: metabolic cardiology. Laguna Beach, CA: Basic Health Publications, Inc; 2011.

Wallace D. C. Mitochondrial genetics: a paradigm for aging and degenerative diseases? *Science.* 1992 May 1; 256(5057):628–32. doi:10.1126/science.1533953.

Wallace D. C. A mitochondrial bioenergetic etiology of disease. *J Clin Invest.* 2013 Apr; 123(4): 1405–12. Epub 2013 Apr 1. doi:10.1172/JCI61398.

Роль митохондрий в заболеваниях сердечно-сосудистой системы

Aon M. A. Mitochondrial dysfunction, alternans, and arrhythmias. *Front Physiol.* 2013 Apr 19; 4:83.

Buja L. M. The pathobiology of acute coronary syndromes: clinical implications and central role of the mitochondria. *Tex Heart Inst J.* 2013; 40(3):221–8.

Gorenkova N., et al. Conformational change of mitochondrial complex I increases ROS sensitivity during ischaemia. *Antioxid Redox Signal.* 2013 Oct; 19(13):1459–68. Epub 2013 Feb 18. doi:10.1089/ars.2012.4698.

Li H., Horke S., Förstermann U. Oxidative stress in vascular disease and its pharmacological prevention. *Trends Pharmacol Sci.* 2013 Jun; 34(6):313–9. Epub 2013 Apr 19. doi:10.1016/j.tips.2013.03.007.

Lonnrot K., et al. Control of arterial tone after long-term coenzyme Q10 supplementation in senescent rats. *Brit J Pharmacol.* 1998 Aug; 124(7):1500–6. doi:10.1038/sj.bjp.0701970.

Karamanlidis G., et al. Defective DNA replication impairs mitochondrial biogenesis in human failing hearts. *Circ Res.* 2010 May 14; 106(9):1541–8. doi:10.1161/CIRCRESAHA.109.212753.

Knight-Lozano C.A., et al. Cigarette smoke exposure and hypercholesterolemia increase mitochondrial damage in cardiovascular tissues. *Circulation.* 2002 Feb 19;105(7):849–54. doi:10.1161/hc0702.103977.

Madamanchi N. R., Runge M. S. Mitochondrial dysfunction in atherosclerosis. *Circ Res.* 2007 Mar 2;100(4):460–73.

Mercer J. R. Mitochondrial bioenergetics and therapeutic intervention in cardiovascular disease. *Pharmacol Ther.* 2014 Jan;141(1):13–20. Epub. doi:10.1016/j.pharmthera.2013.07.011.

Montaigne D., et al. Mitochondrial dysfunction as an arrhythmogenic substrate: a translational proof-of-concept study in patients with metabolic syndrome in whom post-operative atrial fibrillation develops. *J Am Coll Cardiol.* 2013 Oct 15; 62(16):1466–73. Epub 2013 May 1. doi:10.1016/j.jacc.2013.03.061.

Morales C. R., et al. Oxidative stress and autophagy in cardiovascular homeostasis. *Antioxid Redox Signal.* 2014 Jan 20; 20(3):507–518. Epub 2013 May 5. doi:10.1089/ars.2013.5359.

Nazarewicz R. R., Dikalov S. I. Mitochondrial ROS in the pro-hypertensive immune response. *Am J Physiol Regul Integr Comp Physiol.* 2013 May 8; 305:R98–100. Epub. doi:10.1152 /ajpregu.00208.2013.

Oeseburg H., et al. Bradykinin protects against oxidative stress-induced endothelial cell senescence. *Hypertension.* 2009 Feb; 53(Part 2):417–22. doi:10.1161/HYPERTENSIONAHA .108.123729.

Schleicher M., et al. Prohibitin-1 maintains the angiogenic capacity of endothelial cells by regulating mitochondrial function and senescence. *J Cell Biol.* 2008 Jan 14; 180(1):101–12. doi:10.1083/jcb.200706072.

Schriewer J. M., et al. ROS-mediated PARP activity undermines mitochondrial function after permeability transition pore opening during myocar-

dial ischemia-reperfusion. *J Am Heart Assoc.* 2013 Apr 18; 2(2):e000159. doi:10.1161/JAHA.113.000159.

Stride N., et al. Impaired mitochondrial function in chronically ischemic human heart. *Am J Physiol Heart Circ Physiol.* 2013 Mar 29. Epub. doi:10.1152/ajpheart.00991.2012.

Wallace D. C. A mitochondrial paradigm of metabolic and degenerative diseases, aging, and cancer: a dawn for evolutionary medicine. *Annu Rev Genet.* 2005; 39:359–407. doi:10.1146/annurev.genet.39.110304.095751.

Yang Z., et al. Prenatal environmental tobacco smoke exposure promotes adult atherogenesis and mitochondrial damage in apolipoprotein E-/- mice fed a chow diet. *Circulation.* 2004 Dec 14; 110(24):3715–20. doi:10.1161/01.CIR.0000149747.82157.01.

Yang Z., et al. The role of tobacco smoke induced mitochondrial damage in vascular dysfunction and atherosclerosis. *Mutat Res.* 2007 Aug 1; 621(1–2):61–74. doi:10.1016/j.mrfmmm.2007.02.010.

Феномен гладкой мускулатуры

Chitale K., Weber D. S., Webb R. C. RhoA/Rho-kinase, vascular changes and hypertension. *Curr Hypertension Rep.* 2001; 3:139–144. doi:10.1007/s11906-001-0028-4

Feletou M., Vanhoutte P. M. Endothelium-dependent hyperpolarization of vascular smooth muscle cells. *Acta Pharmacol Sin.* 2000 Jan; 21(1):1–18.

Fukata Y., Mutsuki A., Kaibuchi K. Rho-Rho-kinase pathway in smooth muscle contraction and cytoskeletal reorganization of non-muscle cells. *Trends Physiol Sci.* 2001 Jan; 22(1):32–9. doi:10.1016/S0165-6147(00)01596-0.

Jin L., et al. Inhibition of the tonic contraction in the treatment of erectile dysfunction. *Exp Opin Ther Targets.* 2003; 7(2):265–76. doi:10.1517/14728222.7.2.265.

Kao C. Y., Carsten M. E., editors. Cellular Aspects of Smooth Muscle Function. New York: Cambridge Univ. Press, 1997. Chapter 5, Mechanics of smooth muscle contraction; p. 169–208.

Kohlhaas M., Maack C. Calcium release microdomains and mitochondria. *Cardiovasc Res.* 2013 Feb 14; 98:259–68. Epub. doi:10.1093/cvr/cvt032.

Lanza I. R., Sreekumaran Nair K. Regulation of skeletal muscle mitochondrial function: genes to proteins. *Acta Physiol (Oxf).* 2010 Aug; 199(4):529–47. doi:10.1111/j.1748-1716.2010.02124.x.

Li M., et al. High glucose concentrations induce oxidative damage to mitochondrial DNA in explanted vascular smooth muscle cells. *Exp Biol Med.* 2001 Jan 1; 226(5):450–7. doi:10.1177 /153537020122600510.

Mehta S., Webb R. C., Dorrance A. M. The pathophysiology of ischemic stroke: a neuronal and vascular perspective. *J Med Sci.* 2002;22:53–62.

Mills T. M., et al. Inhibition of tonic contraction — a novel way to approach erectile dysfunction? *J Androl.* 2002 Sep 10; 23(5):S5–S9. doi:10.1002/j.1939-4640.2002.tb02294.x.

Mitchell B. M., Chitale K. C., Webb R. C. Vascular smooth muscle contraction and relaxation. In: Izzo JL, Black HR, editors. *Hypertension primer: the essentials of high blood pressure.* Dallas, TX: Am. Heart Assoc.; 2003, p. 97–99.

Morgan K. G. The role of calcium in the control of vascular tone as assessed by the Ca²⁺ indicator aequorin. *Cardiovasc Drugs Ther.* 1990 Oct; 4(5):1355–62.

Ridley A. Rho: theme and variations. *Curr Biol* 1996; 6(10):1256–64. doi:10.1016/S0960-9822 (02)70711-2.

Sah V. P., et al. The role of Rho in G protein-coupled receptor signal transduction. *Annu Rev Pharmacol Toxicol.* 2000;40:459–89. doi:10.1146/annurev.pharmtox.40.1.459.

Solaro R. J. Myosin light chain phosphatase: a Cinderella of cellular signaling. *Circ Res.* 2000 Aug 4; 87:173–5. doi:10.1161/01.RES.87.3.173.

Somlyo A. P., Somlyo A. V. From pharmacomechanical coupling to G-proteins and myosin phosphatase. *Acta Physiol Scand.* 1998 Dec; 164(4):437–48. doi:10.1046/j.1365-201X .1998.00454.x.

Somlyo A. P., Somlyo A. V. Signal transduction by G-proteins, Rho-kinase and protein phosphatase to smooth muscle and non-muscle myosin II. *J Physiol.* 2000; 522(Pt 2):177–85. doi:10.1111/j.1469-7793.2000.t01-2-00177.x.

Somlyo A. P, et al. Pharmacomechanical coupling: the role of calcium, G-proteins, kinases and phosphatases. *Rev Physiol Biochem Pharmacol.* 1999; 134:201–34.

Uehata M., et al. Calcium sensitization of smooth muscle mediated by a Rho-associated protein kinase in hypertension. *Nature.* 1997; 389:990–4. doi:10.1038/40187.

Woodrum D. A., Brophy C. M. The paradox of smooth muscle physiology. *Mol Cell Endocrinol.* 2001; 177(1–2):135–43. doi:10.1016/S0303-7207(01)00407-5.

Роль митохондрий в функционировании нервной системы, головного мозга и в когнитивном здоровье

Allen K. L., et al. Changes of respiratory chain activity in mitochondrial and synaptosomal fractions isolated from the gerbil brain after graded ischaemia. *J Neurochem.* 1995 May; 64(5):2222–9. doi:10.1046/j.1471-4159.1995.64052222.x.

Ankarcrona M., et al. Glutamate-induced neuronal death: a succession of necrosis or apoptosis depending on mitochondrial function. *Neuron.* 1995 Oct; 15(4):961–73. doi:10.1016 /0896-6273(95)90186-8.

Barbiroli B., et al. Coenzyme Q10 improves mitochondrial respiration in patients with mitochondrial cytopathies. An in vivo study on brain and skeletal muscle by phosphorous magnetic resonance spectroscopy. *Cell Molec Biol.* 1997; 43:741–9.

Beal M. F. Aging, energy, and oxidative stress in neurodegenerative diseases. *Ann Neurol.* 1995 Sep; 38(3):357–66. doi:10.1002/ana.410380304.

Beal M. F., et al. Coenzyme Q10 and nicotinamide block striatal lesions produced by the mitochondrial toxin malonate. *Ann Neurol.* 1994; 36(6):882–8. doi:10.1002/ana.410360613.

Beal M. F., et al. Coenzyme Q10 attenuates the 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) induced loss of striatal dopamine and dopaminergic axons in aged mice. *Brain Res.* 1998 Feb;783(1):109–14. doi:10.1016/S0006-8993(97)01192-X.

Bendahan D., et al. 31P NMR spectroscopy and ergometer exercise test as evidence for muscle oxidative performance improvement with coenzyme Q in mitochondrial myopathies. *Neurology*. 1992; 42(6):1203–8.

Berchtold N. C., et al. Brain gene expression patterns differentiate mild cognitive impairment from normal aged and Alzheimer's disease. *Neurobiol Aging*. 2014 Sep; 35(9):1961–72. Epub 2014 Apr 2. doi:10.1016/j.neurobiolaging.2014.03.031.

Bolanos J. P., et al. Nitric oxide-mediated mitochondrial damage in the brain: mechanisms and implications for neurodegenerative diseases. *J Neurochem*. 1997 Jun; 68(6):2227–40. doi:10.1046/j.1471-4159.1997.68062227.x.

Bozner P., et al. The amyloid β protein induces oxidative damage of mitochondrial DNA. *J Neuropathol Exp Neurol*. 1997; 56:1356–62. doi:10.1097/00005072-199712000-00010.

Brookes P. S., et al. Peroxynitrite and brain mitochondria: evidence for increased proton leak. *J Neurochem*. 1998; 70(No 5):2195–02.

Casley C. S., et al. Beta-amyloid inhibits integrated mitochondrial respiration and key enzyme activities. *J Neurochem*. 2002 Jan; 80(1):91–100. doi:10.1046/j.0022-3042.2001.00681.x.

Cassarino D. S., et al. An evaluation of the role of mitochondria in neurodegenerative diseases: mitochondrial mutations and oxidative pathology, protective nuclear responses, and cell death in neurodegeneration. *Brain Res Brain Res Rev*. 1999 Jan; 29(1):1–25. doi:10.1016/S0165-0173(98)00046-0.

Chaturvedi R. K., Flint Beal M. Mitochondrial diseases of the brain. *Free Radic Biol Med*. 2013 Oct; 63:1–29. Epub Apr 5. doi:10.1016/j.freeradbiomed.2013.03.018.

de Moura M. B., dos Santos L. S, Van Houten B. Mitochondrial dysfunction in neurodegenerative diseases and cancer. *Environ Mol Mutagen*. 2010 Jun; 51(5):391–405. doi:10.1002/em.20575.

Favit A., et al. Ubiquinone protects cultured neurons against spontaneous and excitotoxin-induced degeneration. *J Cereb Blood Flow Metab*. 1992;12(No 4):638–45.

Fiskum G., Murphy A. N., Beal M. F. Mitochondria in neurodegeneration: acute ischemia and chronic neurodegenerative diseases. *J Cereb Blood*

Flow Metab. 1999 Apr; 19(4):351–69. doi:10.1097/00004647-199904000-00001.

Kuroda S., Siesjo B. K. Reperfusion damage following focal ischemia: pathophysiology and therapeutic windows. Clin Neurosci. 1997; 4(4):199–212.

Leist M., Nicotera P. Apoptosis, excitotoxicity, and neuropathology. Exp Cell Res. 1998; 239(2): 183–201. doi:10.1006/excr.1997.4026.

Liu J., et al. Memory loss in old rats is associated with brain mitochondrial decay and RNA/ DNA oxidation: partial reversal by feeding acetyl-L-carnitine and/or R-alpha-lipoic acid. Proc Natl Acad Sci U S A. 2002 Feb 19; 99(4):2356–61. doi:10.1073/pnas.261709299.

Love S. Oxidative stress in brain ischemia. Brain Pathol. 1999 Jan; 9(1):119–31. doi:10.1111 /j.1750-3639.1999.tb00214.x.

Matsumoto S., et al. Blockade of the mitochondrial permeability transition pore diminishes infarct size in the rat after transient middle cerebral artery occlusion. J Cereb Blood Flow Metab. 1999; 19(No 7):736–41.

Matthews R. T., et al. Coenzyme Q10 administration increases brain mitochondrial concentrations and exerts neuroprotective effects. Proc Natl Acad Sci U S A. 1998 Jul 21; 95 (15):8892–7.

Mazzio E., et al. Effect of antioxidants on L-glutamate and N-methyl-4-phenylpyridinium ion induced-neurotoxicity in PC12 cells. Neurotoxicology. 2001; 22:283–8.

Mecocci P., et al. Oxidative damage to mitochondrial DNA shows marked age-dependent increases in human brain. Ann Neurol. 1993 Oct; 34(4):609–16. doi:10.1002/ana.410340416.

Mordente A., et al. Free radical production by activated haem proteins: protective effect of coenzyme Q. Molec Aspects Med. 1994; 15(Suppl S109–S115).

Murphy A. N., Fiskum G., Beal F. Mitochondria in neurodegeneration: bioenergetic function in cell life and death. J Cereb Blood Flow Metab. 1999; 19(No 3):231–45.

Musumeci O., et al. Familial cerebellar ataxia with muscle coenzyme Q10 deficiency. Neurology. 2001 Apr 10; 56(7):849–55.

Nam M. K., et al. Essential roles of mitochondrial depolarization in neuron loss through microglial activation and attraction toward neurons. *Brain Res.* 2013 Apr 10; 1505:75–85. Epub Feb 12. doi:10.1016/j.brainres.2013.02.005.

Novelli A., et al. Glutamate becomes neurotoxic via the N-methyl-D-aspartate receptor when intracellular energy levels are reduced. *Brain Res.* 1988 Jun 7; 451(1–2):205–12. doi:10.1016/0006-8993(88)90765-2.

Ristow M., et al. Frataxin activates mitochondrial energy conversion and oxidative phosphorylation. *Proc Natl Acad Sci U S A.* 2000; 97(No 22):12239–43. doi:10.1073 /pnas.220403797.

Schon E. A., Manfredi G. Neuronal degeneration and mitochondrial dysfunction. *J Clin Invest.* 2003 Feb; 111(3):303–12. doi:10.1172/JCI17741.

Schulte E. C., et al. Mitochondrial membrane protein associated neurodegeneration: A novel variant of neurodegeneration with brain iron accumulation. *Mov Disord.* 2013 Feb; 28(2):224–7. Epub 2012 Nov 19. doi:10.1002/mds.25256.

Schulz J. B., et al. Neuroprotective strategies for treatment of lesions produced by mitochondrial toxins: implications for neurodegenerative diseases. *Neuroscience* 71. 1996; 71(4):1043–48. doi:10.1016/0306-4522(95)00527-7.

Sobreira C, et al. Mitochondrial encephalomyopathy with coenzyme Q10 deficiency. *Neurology.* 1997 May; 48(5):1238–43.

Sun T., et al. Motile axonal mitochondria contribute to the variability of presynaptic strength. *Cell Rep.* 2013 Aug 15; 4(3):413–9. Epub 2013 Jul 23. doi:10.1016/j.celrep.2013.06.040.

Tatton W. G., Chalmers-Redman R. M. Mitochondria in neurodegenerative apoptosis: an opportunity for therapy? *Ann Neurol.* 1998; 44(3 Suppl 1):S. 134–S. 141. doi:10.1002/ana.410440720.

Tatton W. G, Olanow C. W. Apoptosis in neurodegenerative diseases: the role of mitochondria. *Biochim Biophys Acta.* 1999 Feb 9; 1410(2):195–213. doi:10.1016/S0005-2728(98)00167-4.

Turner C., Schapira A. H. Mitochondrial dysfunction in neurodegenerative disorders and ageing. *Adv Exp Med Biol.* 2001; 487:229–51.

Veitch K. et al. Global ischemia induces a biphasic response of the mitochondrial respiratory chain. Anoxic pre-perfusion protects against ischaemic damage. *Biochem J.* 1992 Feb 1; 281(Pt 3):709–15.

Volpe M., Cosentino F. Abnormalities of endothelial function in the pathogenesis of stroke: the importance of endothelin. *J Cardiovasc Pharmacol.* 2000; 35(4 Suppl 2):S. 45–S. 48.

Болезнь Альцгеймера: не забывайте о митохондриях!

Berger A. The Alzheimer's antidote: Using a low-carb, high-fat diet to fight Alzheimer's disease, memory loss, and cognitive decline. White River Junction, VT: Chelsea Green Publishing, 2017.

Blass J. P. The mitochondrial spiral. An adequate cause of dementia in the Alzheimer's syndrome. *Ann NY Acad Sci.* 2000; 924:170–83. doi:10.1111/j.1749-6632.2000.tb05576.x.

Bonilla E., et al. Mitochondrial involvement in Alzheimer's disease. *Biochim Biophys Acta.* 1999 Feb 9; 1410(2):171–82. doi:10.1016/S0005-2728(98)00165-0.

Brown A. M., et al. Correlation of the clinical severity of Alzheimer's disease with an aberration in mitochondrial DNA (mtDNA). *J Mol Neurosci.* 2001 Feb; 16(1):41–8. doi:10.1385 /JMN:16:1:41.

Cavallucci V., Ferraina C., D'Amelio M. Key role of mitochondria in Alzheimer's disease synaptic dysfunction. *Curr Pharm Des.* 2013; 19(36):6440–50. Epub 2013 Feb 13.

Chen J. X., Yan S. D. Amyloid-beta-induced mitochondrial dysfunction. *J Alzheimers Dis.* 2007 Sep; 12(2):177–84. doi:10.3233/JAD-2007-12208.

Duboff B., Feany M., Götz J. Why size matters — balancing mitochondrial dynamics in Alzheimer's disease. *Trends Neurosci.* 2013 Jun; 36(6):325–35. Epub 2013 Apr 11. doi:10.1016 /j.tins.2013.03.002.

Gabuzda D., et al. Inhibition of energy metabolism alters the processing of amyloid precursor protein and induces a potentially amyloidogenic derivative. *J Biol Chem.* 1994 May 6; 269(18):13623–8.

Harman D. A hypothesis on the pathogenesis of Alzheimer's disease. *Ann N Y Acad Sci.* 1996 Jun 15;786:152–68. doi:10.1111/j.1749-6632.1996.tb39059.x.

Hu H., et al. A mitocentric view of Alzheimer's disease. *Mol Neurobiol.* 2016 Oct 1. Epub ahead of print. doi:10.1007/s12035-016-0117-7.

Lustbader J. W., et al. ABAD directly links Abeta to mitochondrial toxicity in Alzheimer's disease. *Science.* 2004 Apr 16; 304(5669):448–52. doi:10.1126/science.1091230.

Mariani C., et al. Muscle biopsy in Alzheimer's disease: morphological and biochemical findings. *Clin Neuropathol.* 1991 Jul; 10(4):171–6.

Mark R. J., et al. Amyloid b-peptide impairs glucose transport in hippocampal and cortical neurons: involvement of membrane lipid peroxidation. *J Neurosci.* 1997 Feb 1; 17(3): 1046–54.

Markesbery W. R. Oxidative stress hypothesis in Alzheimer's disease. *Free Radic Biol Med.* 1997; 23(1):134–47. doi:10.1016/S0891-5849(96)00629-6.

Markesbery W. R. Oxidative alterations in Alzheimer's disease. *Brain Pathol.* 1999 Jan; 9(1): 133–46. doi:10.1111/j.1750-3639.1999.tb00215.x.

Muller W. E., et al. Mitochondrial dysfunction: common final pathway in brain aging and Alzheimer's disease—therapeutic aspects. *Mol Neurobiol.* 2010 Jun; 41(2–3):159–71. doi:10.1007/s12035-010-8141-5.

Munch G., et al. Alzheimer's disease — synergistic effects of glucose deficit, oxidative stress and advanced glycation endproducts. *J Neural Transm (Vienna).* 1998; 105(4–5):439–61. doi:10.1007/s007020050069.

Nia S. S., et al. New pathogenic variations of mitochondrial DNA in Alzheimer disease! [letter]. *J Res Med Sci.* 2013 Mar; 18(3):269.

Nicotera P., Leist M., Manzo L. Neuronal cell death: a demise with different shapes. *Trends Pharmacol Sci.* 1999 Feb 1; 20(2):46–51. doi:10.1016/S0165-6147(99)01304-8.

Ogawa M., et al. Altered energy metabolism in Alzheimer's disease. *J Neurol Sci.* 1996 Jul; 139(1):78–82. doi:10.1016/0022-510X(96)00033-0.

Sery O., et al. Molecular mechanisms of neuropathological changes in Alzheimer's disease: a review. *Folia Neuropathol.* 2013; 51(1):1–9. doi:10.5114/fn.2013.34190.

Smith M. A., et al. Widespread peroxynitrite-mediated damage in Alzheimer's disease. *J Neurosci* 1997 Apr 15; 17(8):2653–7.

Sochocka M., et al. Vascular oxidative stress and mitochondrial failure in the pathobiology of Alzheimer's disease: new approach to therapy. *CNS Neurol Disord Drug Targets*. 2013 Sep; 12(6):870–81. Epub Feb 27. doi:10.2174/18715273113129990072.

Wang X., et al. Impaired balance of mitochondrial fission and fusion in Alzheimer's disease. *J Neurosci*. 2009 Jul 15; 29(28):9090–103. doi:10.1523/JNEUROSCI.

Webster M. T., et al. The effects of perturbed energy metabolism on the processing of amyloid precursor protein in PC12 cells. *J Neural Transm*. 1998 Nov; 105(8–9):839–53. doi:10.1007/s007020050098.

Ying W. Deleterious network: a testable pathogenetic concept of Alzheimer's disease. *Gerontology*. 1997; 43:242–53. doi:10.1159/000213856.

Передача и болезнь Альцгеймера

Adeghate E., Donath T., Adem A. Alzheimer disease and diabetes mellitus: do they have anything in common? *Curr Alzheimer Res*. 2013 Jul; 10(6):609–17. Epub Apr 29. doi:10.2174/15672050113109990009.

Cetinkalp S., Simsir I. Y., Ertek S. Insulin resistance in brain and possible therapeutic approaches. *Curr Vasc Pharmacol*. 2014; 12(4):553–64. Epub Apr 25. doi:10.2174/1570161112999140206 130426.

Geda Y. E. Abstract 3431. Paper presented at: American Academy of Neurology (AAN) 64th Annual Meeting; 2012 Apr 21–28; New Orleans, Louisiana.

Mastrogiacomo F., Bergeron C., Kish E. J. Brain alpha-ketoglutarate dehydrogenase complex activity in Alzheimer's disease. *J Neurochem*. 1993 Dec; 61(6):2007–14. doi:10.1111/j.1471-4159.1993.tb07436.x.

Болезнь Паркинсона: новый взгляд на терапию ДОФА-содержащими препаратами

Abou-Sleiman P. M., Muqit M. M., Wood N. W. Expanding insights of mitochondrial dysfunction in Parkinson's disease. *Nat Rev Neurosci*. 2006 Mar; 7(3):207–19. doi:10.1038/nrn1868.

Beal M. F. Therapeutic approaches to mitochondrial dysfunction in Parkinson's disease. *Parkinsonism Relat Disord.* 2009 Dec; 15 Suppl 3:S189–S194. doi:10.1016/S1353-8020(09) 70812-0.

Beal M. F., et al. Coenzyme Q10 attenuates the 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) induced loss of striatal dopamine and dopaminergic axons in aged mice. *Brain Res.* 1998 Feb; 783(1):109–14. doi:10.1016/S0006-8993(97)01192-X.

Bender A., et al. TOM40 mediates mitochondrial dysfunction induced by α -synuclein accumulation in Parkinson's disease. *PLoS One.* 2013 Apr 23; 8(4):e62277.

Berndt N., Holzshutter H. G., Bulik S. Implications of enzyme deficiencies on the mitochondrial energy metabolism and ROS formation of neurons involved in rotenone-induced Parkinson's disease: A model-based analysis. *FEBS J.* 2013 Sep 12; 280(20):5080–93. Epub 2013 Aug 13. doi:10.1111/febs.12480.

Dolle C., et al. Defective mitochondrial DNA homeostasis in the substantia nigra in Parkinson disease. *Nat Commun.* 2016 Nov 22; 7:13548.

Ebadi M., et al. Ubiquinone (coenzyme q10) and mitochondria in oxidative stress of Parkinson's disease. 2001. *Biol Signals Recept* 10:224–53. doi:10.1038/ncomms13548.

Freeman D., et al. Alpha-synuclein induces lysosomal rupture and cathepsin dependent reactive oxygen species following endocytosis. *PLoS One.* 2013 Apr 25; 8(4):e62143.

Haas R. H., et al. Low platelet mitochondrial complex I and complex II/III activity in early untreated Parkinson's disease. *Ann Neurol.* 1995 Jun; 37(6):714–22. doi:10.1002/ana.410370604.

Henchcliffe C., Beal M. F. Mitochondrial biology and oxidative stress in Parkinson disease pathogenesis. *Nat Clin Pract Neurol.* 2008 Nov; 4(11):600–9. doi:10.1038/ncpneuro0924.

Hosamani R., Muralidhara. Acute exposure of *Drosophila melanogaster* to paraquat causes oxidative stress and mitochondrial dysfunction. *Arch Insect Biochem Physiol.* 2013 May; 83(1):25–40. Epub 2013 Apr 5.

Isobe C., Abe T., Terayama Y. Levels of reduced and oxidized coenzyme Q-10 and 8-hydroxy-2'-deoxyguanosine in the cerebrospinal fluid of patients

living with Parkinson's disease demonstrate that mitochondrial oxidative damage and/or oxidative DNA damage contributes to the neurodegenerative process. *Neurosci Lett*. 2010 Jan 18; 469(1):159–63. Epub 2009 Nov 26.

Lehmann S., Martins L. M. Insights into mitochondrial quality control pathways and Parkinson's disease. *J Mol Med (Berl)*. 2013 Jun; 91(6):665–71. Epub May 4. doi:10.1007/s00109-013-1044-y.

Li D. W., et al. α -lipoic acid protects dopaminergic neurons against MPP⁺-induced apoptosis by attenuating reactive oxygen species formation. *Int J Mol Med*. 2013 Jul;32(1):108–14. Epub Apr 24. doi:10.3892/ijmm.2013.1361.

Lin T. K., et al. Mitochondrial dysfunction and biogenesis in the pathogenesis of Parkinson's disease. *Chang Gung Med J*. 2009 Nov–Dec; 32(6):589–99.

Lodi R., et al. Antioxidant treatment improves in vivo cardiac and skeletal muscle bioenergetics in patients with Friedreich's ataxia. *Ann Neurol*. 2001 May 1; 49(5):590–6. doi:10.1002/ana.1001.

Mena M. A., et al. Neurotoxicity of levodopa on catecholamine-rich neurons. *Mov Disord*. 1992; 7(1):23–31. doi:10.1002/mds.870070105.

Mizuno Y., et al. Role of mitochondria in the etiology and pathogenesis of Parkinson's disease. *Biochima et Biophysica Acta*. 1995 May 24; 1271(1):265–74. doi:10.1016/0925-4439(95)00038-6.

Mizuno Y., et al. Mitochondrial dysfunction in Parkinson's disease. *Ann Neurol*. 1998 Sep; 44 (3 Suppl 1):S. 99–S. 109.

Musumeci O., et al. Familial cerebellar ataxia with muscle coenzyme Q10 deficiency. *Neurology*. 2001 Apr 10; 56(7):849–55.

Nakamura K. α -Synuclein and mitochondria: partners in crime? *Neurotherapeutics*. 2013 Jul; 10(3):391–9. Epub Mar 20. doi:10.1007/s13311-013-0182-9.

Olanow C. W., et al. The effect of deprenyl and levodopa on the progression of Parkinson's disease. *Ann Neurol*. Nov 1995; 38(5):771–7. doi:10.1002/ana.410380512.

Perfeito R., Cunha-Oliveira T., Rego A. C. Revisiting oxidative stress and mitochondrial dysfunction in the pathogenesis of Parkinson's dis-

ease — resemblance to the effect of amphetamine drugs of abuse. *Free Radic Biol Med.* 2012 Nov 1; 53(9):1791–806. doi:10.1016/j.freeradbiomed.2012.08.569.

Przedborski S., Jackson-Lewis V., Fahn S. Antiparkinsonian therapies and brain mitochondrial complex I activity. *Mov Disord.* May 1995; 10(3):312–7. doi:10.1002/mds.870100314.

Schapira A. H., et al. Novel pharmacological targets for the treatment of Parkinson's disease. *Nat Rev Drug Discov.* 2006 Oct; 5(10):845–54. doi:10.1038/nrd2087.

Shults C. W., et al. Carbidopa/levodopa and selegiline do not affect platelet mitochondrial function in early Parkinsonism. *Neurol.* 1995 Feb; 45(2):344–8. doi:10.1212/WNL.45.2.344.

Shults C. W., et al. Coenzyme Q10 levels correlate with the activities of complexes I and II/III in mitochondria from parkinsonian and nonparkinsonian subjects. *Ann Neurol.* 1997 Aug. 42(2):261–4. doi:10.1002/ana.410420221.

Shults C. W., et al. Absorption, tolerability, and effects on mitochondrial activity of oral coenzyme Q10 in parkinsonian patients. *Neurology.* 1998 Mar; 50(3):793–5. doi:10.1212/WNL.50.3.793.

Shults C. W., Haas R. H., Beal M. F. A possible role of coenzyme Q10 in the etiology and treatment of Parkinson's disease. *Biofactors.* 1999; 9(2–4):267–72. doi:10.1002/biof.5520090223.

Smith T. S., Parker W. D., Bennell J. P. Jr. L-dopa increases nigral production of hydroxyl radicals in vivo: potential L-dopa toxicity? *Neuroreportl.* 1994 Apr 14; 5(8):1009–11. doi:10.1097/00001756-199404000-00039.

Subramaniam S. R., Chesselet M. F. Mitochondrial dysfunction and oxidative stress in Parkinson's disease. *Prog Neurobiol.* 2013 Jul–Aug; 106–107:17–32. Epub 2013 Apr 30. doi:10.1016/j.pneurobio.2013.04.004.

Thomas B., Beal M. F. Mitochondrial therapies for Parkinson's disease. *Mov Disord.* 2010; 25 Suppl 1:S155–S160. doi:10.1002/mds.22781.

Trempe J. F., Fon E. A. Structure and function of Parkin, PINK1, and DJ-1, the Three Musketeers of neuroprotection. *Front Neurol.* 2013 Apr 19; 4:38. doi:10.3389/fneur.2013.00038.

Wu R. M., et al. Apparent antioxidant effect of L-deprenyl on hydroxyl radical generation and nigral injury elicited by MPP+ in vivo. *Eur J Pharmacol.* 1993 Oct 26; 243(3):241–7. doi:10.1016/0014-2999(93)90181-G.

Депрессия

Hroudova J., et al. Mitochondrial respiration in blood platelets of depressive patients. *Mitochondrion.* 2013 Nov; 13(6):795–800. Epub May 17. doi:10.1016/j.mito.2013.05.005.

Lopresti A. L., Hood S. D., Drummond P. D. A review of lifestyle factors that contribute to important pathways associated with major depression: diet, sleep and exercise. *J Affect Disord.* 2013 May 15; 148(1):12–27. Epub Feb 14. doi:10.1016/j.jad.2013.01.014.

Morava E., Kozicz T. The economy of stress (mal)adaptation. *Neurosci Biobehav Rev.* 2013 May; 37(4):668–80. Epub 2013 Feb 13. doi:10.1016/j.neubiorev.2013.02.005.

Seibenhener M. L., et al. Behavioral effects of SQSTM1/p62 overexpression in mice: support for a mitochondrial role in depression and anxiety. *Behav Brain Res.* 2013 Jul 1; 248:94–103. Epub Apr 13. doi:10.1016/j.bbr.2013.04.006.

Tobe E. H. Mitochondrial dysfunction, oxidative stress, and major depressive disorder. *Neuropsychiatr Dis Treat.* 2013; 9:567–73. Epub 2013 Apr 26. doi:10.2147/NDT.S44282.

Синдром дефицита внимания и гиперактивности: митохондрии

Attwell D., Gibb A. Neuroenergetics and the kinetic design of excitatory synapses. *Nat Rev Neurosci.* 2005 Nov; 6(11):841–9. doi:10.1038/nrn1784.

Barkley R. A. Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. *Psychol Bull.* 1997 Jan; 121(1):65–94. doi:10.1037/0033-2909.121.1.65.

Castellanos F. X., Tannock R. Neuroscience of attention-deficit/hyperactivity disorder: the search for endophenotypes. *Nat Rev Neurosci.* 2002 Aug; 3(8):617–628. doi:10.1038/nrn896.

Charlton R. A., et al. White matter damage on diffusion tensor imaging correlates with age-related cognitive decline. *Neurology*. 2006 Jan 24; 66(2):217–22. doi:10.1212/01.wnl.0000194256.15247.83.

Chovanova Z., et al. Effect of polyphenolic extract, pycnogenol, on the level of 8-oxoguanine in children suffering from attention deficit/hyperactivity disorder. *Free Radic Res*. 2006 Sep; 40(9):1003–10. doi:10.1080/10715760600824902.

Cotter D. R., Pariante C. M., Everall I. P. Glial cell abnormalities in major psychiatric disorders: the evidence and implications. *Brain Res Bull*. 2001 Jul 15; 55(5):585–95. doi:10.1016 /S0361-9230(01)00527-5.

Dienel G. A. Astrocytic energetics during excitatory neurotransmission: what are contributions of glutamate oxidation and glycolysis? *Neurochem Int*. 2013 Oct; 63(4):244–58. Epub 2013 Jul 6. doi:10.1016/j.neuint.2013.06.015.

Dvorakova M., et al. The effect of polyphenolic extract from pine bark, pycnogenol on the level of glutathione in children suffering from attention deficit hyperactivity disorder (ADHD). *Redox Rep*. 2006; 11(4):163–72. doi:10.1179/135100006X116664.

Dvorakova M., et al. Urinary catecholamines in children with attention deficit hyperactivity disorder (ADHD): modulation by a polyphenolic extract from pine bark (pycnogenol). *Nutr Neurosci*. 2007 Jun–Aug;10(3–4):151–7. doi:10.1080/09513590701565443.

Ernst M., et al. Intravenous dextroamphetamine and brain glucose metabolism. *Neuropsychopharmacology*. 1997 Dec, 17(6):391–401. doi:10.1016/S0893-133X(97)00088-2.

Fagundes A. O., et al. Chronic administration of methylphenidate activates mitochondrial respiratory chain in brain of young rats. *Int J Dev Neurosci*. 2007 Feb; 25(1):47–51. Epub 2006 Dec 22. doi:10.1016/j.ijdevneu.2006.11.001.

Gladden L. B. Lactate metabolism: a new paradigm for the third millennium. *J Physiol*. 2004 Jul 1;558(1):5–30.

Hansson E., Ronnback L. Altered neuronal-glia signaling in glutamatergic transmission as a unifying mechanism in chronic pain and mental fatigue. *Neurochem Res*. 2004 May; 29(5):989–96.

Hirst W. D., et al. Cultured astrocytes express messenger RNA for multiple serotonin receptor subtypes, without functional coupling of 5-HT1 receptor subtypes to adenylyl cyclase. *Brain Res Mol Brain Res.* 1998 Oct 30; 61(1–2):90–9. doi:10.1016/S0169-328X(98)00206-X.

Jessen K. R. Glial cells. *Int J Biochem Cell Biol.* 2004 Oct;36(10):1861–7. doi:10.1016/j.biocel.2004.02.023.

Karayanidis E., et al. ERP differences in visual attention processing between attention-deficit hyperactivity disorder and control boys in the absence of performance differences. *Psychophysiology.* 2000 May; 37(3):319–33. doi:10.1111/1469-8986.3730319.

Kasischke K. A., et al. Neural activity triggers neuronal oxidative metabolism followed by astrocytic glycolysis. *Science.* 2004 Jul 2; 305(5608):99–103. doi:10.1126/science.1096485.

Klorman R., et al. Methylphenidate speeds evaluation processes of attention deficit disorder adolescents during a continuous performance test. *J Abnorm Child Psychol.* 1991 Jun; 19(3):263–83.

Lepine R., Parrouillet P., Camos V. What makes working memory spans so predictive of high-level cognition? *Psychon Bull Rev.* 2005 Feb; 12(1):165–70.

Magistretti P. J., Pellerin L. Cellular mechanisms of brain energy metabolism and their relevance to functional brain imaging. *Philos Trans R Soc Lond B Biol Sci.* 1999 Jul 29; 354(1387):1155–63. doi:10.1098/rstb.1999.0471.

Miyazaki I., et al. Direct evidence for expression of dopamine receptors in astrocytes from basal ganglia. *Brain Res.* 2004 Dec 10; 1029(1):120–3. doi:10.1016/j.brainres.2004.09.014.

Moldrich R. X., et al. Astrocyte mGlu(2/3)-mediated cAMP potentiation is calcium sensitive: studies in murine neuronal and astrocyte cultures. *Neuropharmacology.* 2002 Aug;43(2):189–203. doi:10.1016/S0028-3908(02)00111-9.

Ostrow L. W., Sachs F. Mechanosensation and endothelin in astrocytes—hypothetical roles in CNS pathophysiology. *Brain Res Brain Res Rev.* 2005 Jun; 48(3):488–508. doi:10.1016/j.brainresrev.2004.09.005.

Pellerin L. How astrocytes feed hungry neurons. *Mol Neurobiol.* 2005 Aug; 32(1):59–72. doi:10.1385/MN:32:1:059.

Pellerin L., Magistretti P. J. Ampakine CX546 bolsters energetic response of astrocytes: a novel target for cognitive-enhancing drugs acting as alpha-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid (AMPA) receptor modulators. *J Neurochem.* 2005 Feb; 92(3):668–77. doi:10.1111/j.1471-4159.2004.02905.x.

Perchet C., et al. Attention shifts and anticipatory mechanisms in hyperactive children: an ERP study using the Posner paradigm. *Biol Psychiatry.* 2001 Jul 1; 50(1):44–57. doi:10.1016/S0006-3223(00)01119-7.

Potgieter S., Vervisch J., Lagae L. Event related potentials during attention tasks in VLBW children with and without attention deficit disorder. *Clin Neurophysiol.* 2003 Oct; 114(10): 1841–9. doi:10.1016/S1388-2457(03)00198-6.

Ronnback L., Hansson E. On the potential role of glutamate transport in mental fatigue. *J Neuroinflammation.* 2004 Nov; 1(22).

Ross B. M., et al. Increased levels of ethane, a non-invasive marker of n-3 fatty acid oxidation, in breath of children with attention deficit hyperactivity disorder. *Nutr Neurosci.* 2003 Oct; 6(5):277–81. doi:10.1080/10284150310001612203.

Sagvolden T., et al. A dynamic developmental theory of attention-deficit/hyperactivity disorder (ADHD) predominantly hyperactive/impulsive and combined subtypes. *Behav Brain Sci.* 2005 Jun;28(3):397–419. doi:10.1017/S0140525X05000075.

Sanchez-Abarca L. I., Taberner A., Medina J. M. Oligodendrocytes use lactate as a source of energy and as a precursor of lipids. *Glia.* 2001 Dec; 36(3):321–9. doi:10.1002/glia.1119.

Sergeant J. The cognitive-energetic model: an empirical approach to attention-deficit hyperactivity disorder. *Neurosci Biobehav Rev.* 2000 Jan; 24(1):7–12. doi:10.1016/S0149-7634(99)00060-3.

Sergeant J. A., et al. The top and the bottom of ADHD: a neuropsychological perspective. *Neurosci Biobehav Rev.* 2003 Nov; 27(7):583–92. doi:10.1016/j.neubiorev.2003.08.004.

Smithee J. A., et al. Methylphenidate does not modify the impact of response frequency or stimulus sequence on performance and event-related potentials of children with attention deficit hyperactivity disorder. *J Abnorm Child Psychol.* 1998 Aug; 26(4):233–45.

Sonuga-Barke E. J. The dual pathway model of AD/HD: an elaboration of neuro-developmental characteristics. *Neurosci Biobehav Rev.* 2003 Nov; 27(7):593–604. doi:10.1016/j.neubiorev.2003.08.005.

Sunohara G. A., et al. Effect of methylphenidate on attention in children with attention deficit hyperactivity disorder (ADHD): ERP evidence. *Neuropsychopharmacology.* 1999;21:218–28. doi:10.1016/S0893-133X(99)00023-8.

Todd R. D., Botteron K. N. Is attention-deficit/hyperactivity disorder an energy deficiency syndrome? *Biol Psychiatry.* 2001 Aug 1; 50(3):151–8. doi:10.1016/S0006-3223(01)01173-8.

Volkow N. D., et al. Differences in regional brain metabolic responses between single and repeated doses of methylphenidate. *Psychiatry Res.* 1998 Jul 15; 83(1):29–36. doi:10.1016/S0925-4927(98)00025-0.

West J., et al. Response inhibition, memory and attention in boys with attention-deficit/ hyperactivity disorder. *Educational Psychology.* 2002; 22:533–51.

Zametkin A., et al. Cerebral glucose metabolism in adults with hyperactivity of childhood onset. *N Engl J Med.* 1990 Nov 15; 323(20):1361–6. doi:10.1056/NEJM199011153232001.

Синдром хронической усталости, миалгический энцефаломиелит и фибромиалгия

Aaron L. A., Buchwald D. Chronic diffuse musculoskeletal pain, fibromyalgia and co-morbid unexplained clinical conditions. *Best Pract Res Clin Rheumatol.* 2003 Aug;17(4):563–74. doi:10.1016/S1521-6942(03)00033-0.

Baraniuk J. N., et al. A chronic fatigue syndrome – related proteome in human cerebrospinal fluid. *BMC Neurol.* 2005 Dec; 5:22. doi:10.1186/1471-2377-5-22.

Barnes P. R., et al. Skeletal muscle bioenergetics in the chronic fatigue syndrome. *J Neurol Neurosurg Psychiatry.* 1993 Jun; 56(6):679–83. doi:10.1136/jnnp.56.6.679.

Bengtsson A., Henriksson K. G. The muscle in fibromyalgia — a review of Swedish studies. *J Rheumatol Suppl.* 1989 Nov; 19:144–9.

Brenu E. W., et al. Immunological abnormalities as potential biomarkers in chronic fatigue syndrome/myalgic encephalomyelitis. *J Transl Med.* 2011 May 28; 9:81. doi:10.1186/1479-5876-9-81.

Brown M. M., Jason L. A. Functioning in individuals with chronic fatigue syndrome: increased impairment with co-occurring multiple chemical sensitivity and fibromyalgia. *Dyn Med.* 2007 Jul 30;6:9. doi:10.1186/1476-5918-6-9.

Buchwald D., Garrity D. Comparison of patients with chronic fatigue syndrome, fibromyalgia, and multiple chemical sensitivities. *Arch Intern Med.* 1994 Sep 26; 154(18):2049–53. doi:10.1001/archinte.1994.00420180053007.

Castro-Marrero J., et al. Could mitochondrial dysfunction be a differentiating marker between chronic fatigue syndrome and fibromyalgia? *Antioxid Redox Signal.* 2013 Nov 20;19(15):1855–60. Epub Apr 22. doi:10.1089/ars.2013.5346.

Cordero M. D., et al. Coenzyme Q(10): a novel therapeutic approach for fibromyalgia? case series with 5 patients. *Mitochondrion.* 2011 Jul; 11(4):623–5. doi:10.1016/j.mito.2011.03.122.

Cordero M. D., et al. Coenzyme Q10 in salivary cells correlate with blood cells in fibromyalgia: improvement in clinical and biochemical parameter after oral treatment. *Clin Biochem.* 2012 Apr; 45(6):509–11. doi:10.1016/j.clinbiochem.2012.02.001.

Cordero M. D., et al. Can coenzyme Q10 improve clinical and molecular parameter in fibromyalgia? *Antioxid Redox Signal.* 2013 Oct 20; 19(12):1356–61. Epub 2013 Mar 4. doi:10.1089/ars.2013.5260.

Cordero M. D., et al. Is inflammation a mitochondrial dysfunction-dependent event in fibromyalgia? *Antioxid Redox Signal.* 2013 Mar 1;18(7):800–7. doi:10.1089/ars.2012.4892.

Devanur L. D., Kerr J. R. Chronic fatigue syndrome. *J Clin Virol.* 2006 Nov; 37(3):139–50. doi:10.1016/j.jcv.2006.08.013.

Exley C., et al. A role for the body burden of aluminium in vaccine-associated macrophagic myofasciitis and chronic fatigue syndrome. *Med Hypotheses.* 2009 Feb; 72(2):135–9. doi:10.1016/j.mehy.2008.09.040.

Jammes Y., et al. Chronic fatigue syndrome: assessment of increased oxidative stress and altered muscle excitability in response to incremental

exercise. *J Intern Med.* 2005 Mar; 257(3): 299–310. doi:10.1111/j.1365-2796.2005.01452.x.

Kennedy G., et al. Oxidative stress levels are raised in chronic fatigue syndrome and are associated with clinical symptoms. *Free Radic Biol Med.* 2005 Sep 1; 39(5):584–9. doi:10.1016/j.freeradbiomed.2005.04.020.

Lanea R. J., et al. Heterogeneity in chronic fatigue syndrome: evidence from magnetic resonance spectroscopy of muscle. *Neuromuscul Disord.* 1998 May; 8(3–4):204–9. doi:10.1016/S0960-8966(98)00021-2.

Maes M. Inflammatory and oxidative and nitrosative stress pathways underpinning chronic fatigue, somatization and psychosomatic symptoms. *Curr Opin Psychiatry.* 2009 Jan; 22(1):75–83

Manuel-y-Keenoy B., et al. Antioxidant status and lipoprotein peroxidation in chronic fatigue syndrome. *Life Sci.* 2001 Mar 16; 68(17):2037–49. doi:10.1016/S0024-3205(01)01001-3.

Meeus M., et al. The role of mitochondrial dysfunctions due to oxidative and nitrosative stress in the chronic pain or chronic fatigue syndromes and fibromyalgia patients: peripheral and central mechanisms as therapeutic targets? *Expert Opin Ther Targets.* 2013 Sep; 17(9): 1081–9. Epub Jul 9. doi:10.1517/14728222.2013.818657.

Miyamae T., et al. Increased oxidative stress and coenzyme Q10 deficiency in juvenile fibromyalgia: amelioration of hypercholesterolemia and fatigue by ubiquinol-10 supplementation. *Redox Rep.* 2013; 18(1):12–9. doi:10.1179/1351000212Y.0000000036.

Myhill S. CFS — The central cause: mitochondrial failure [Internet]. Doctor Myhill.co.uk. [Cited 2017 June 29]. Available from: http://drmyhill.co.uk/wiki/CFS_-_The_Central_Cause:_Mitochondrial_Failure.

Myhill S., Booth N. E., McLaren-Howard J. Chronic fatigue syndrome and mitochondrial dysfunction. *Int J Clin Exp Med.* 2009; 2(1):1–16.

Nancy A. L., Shoenfeld Y. Chronic fatigue syndrome with autoantibodies — the result of an augmented adjuvant effect of hepatitis-B vaccine and silicone implant. *Autoimmun Rev.* 2008 Oct; 8(1):52–5. doi:10.1016/j.autrev.2008.07.026.

Ortega-Hernandez O. D., Shoenfeld Y. Infection, vaccination, and autoantibodies in chronic fatigue syndrome, cause or coincidence?

Ann N Y Acad Sci. 2009 Sep; 1173:600–9. doi:10.1111/j.1749-6632.2009.04799.x.

Ozgozmen S., et al. Current concepts in the pathophysiology of fibromyalgia: the potential role of oxidative stress and nitric oxide. *Rheumatol Int.* 2006 May; 26(7):585–97. doi:10.1007/s00296-005-0078-z.

Villanova M., et al. Mitochondrial myopathy mimicking fibromyalgia syndrome. *Muscle Nerve.* 1999 Feb; 22(2):289–91. doi:10.1002/(SICI)1097-4598(199902)22:2<289::AID-MUS26>3.0.CO;2-O.

Zhang C., et al. Unusual pattern of mitochondrial DNA deletions in skeletal muscle of an adult human with chronic fatigue syndrome. *Hum Mol Genet.* 1995;4:751–4. doi:10.1093/hmg/4.4.751.

Диабет II типа

Alikhani Z., et al. Advanced glycation end products enhance expression of pro-apoptotic genes and stimulate fibroblast apoptosis through cytoplasmic and mitochondrial pathways. *J Biol Chem.* 2005 Apr 1; 280(13):12087–95. doi:10.1074/jbc.M406313200.

Allister E. M., et al. UCP2 regulates the glucagon response to fasting and starvation. *Diabetes.* 2013 May; 62(5):1623–33. Epub 2013 Feb 22. doi:10.2337/db12-0981.

Bach D., et al. Mitofusin-2 determines mitochondrial network architecture and mitochondrial metabolism. A novel regulatory mechanism altered in obesity. *J Biol Chem.* 2003 May 9; 278(19):17190–7. doi:10.1074/jbc.M212754200.

Barbosa M. R., et al. Hydrogen peroxide production regulates the mitochondrial function in insulin resistant muscle cells: effect of catalase overexpression. *Biochim Biophys Acta.* 2013 Oct; 1832(10):1591–604. Epub 2013 May 2. doi:10.1016/j.bbadis.2013.04.029.

Befroy D. E., et al. Impaired mitochondrial substrate oxidation in muscle of insulin-resistant offspring of type 2 diabetic patients. *Diabetes.* 2007 May; 56(5):1376–81. Epub 2007 Feb 7. doi:10.2337/db06-0783.

Feng B., Ruiz M. A., Chakrabarti S. Oxidative-stress-induced epigenetic changes in chronic diabetic complications. *Can J Physiol Pharmacol.* 2013 Mar; 91(3):213–20. doi:10.1139/cjpp-2012-0251.

- Fiorentino T. V., et al.* Hyperglycemia-induced oxidative stress and its role in diabetes mellitus related cardiovascular diseases. *Curr Pharm Des.* 2013;19(32):5695–703. Epub 2013 Feb 20. doi:10.2174/1381612811319320005.
- Frohnert B. I., Bernlohr D. A.* Protein carbonylation, mitochondrial dysfunction, and insulin resistance. *Adv Nutr.* 2013 Mar 1; 4(2):157–63. doi:10.3945/an.112.003319.
- Goodpaster B. H.* Mitochondrial deficiency is associated with insulin resistance. *Diabetes.* 2013 Apr; 62(4):1032–5. doi:10.2337/db12-1612.
- Graier W. F., Malli R., Kostner G. M.* Mitochondrial protein phosphorylation: instigator or target of lipotoxicity? *Trends Endocrinol Metab.* 2009 May; 20(4):186–93. doi:10.1016/j.tem.2009.01.004.
- Hamilton J. A., Kamp F.* How are free fatty acids transported in membranes? Is it by proteins or by free diffusion through the lipids? *Diabetes.* 1999 Dec;48(12):2255–69. doi:10.2337/diabetes.48.12.2255.
- Hesselink M. K., Schrauwen-Hinderling V, Schrauwen P.* Skeletal muscle mitochondria as a target to prevent or treat type 2 diabetes mellitus. *Nat Rev Endocrinol.* 2016 Nov; 12(11):633–45. Epub 2016 Jul 22. doi:10.1038/nrendo.2016.104.
- Hipkiss A. R.* Aging, proteotoxicity, mitochondria, glycation, NAD and carnosine: possible inter-relationships and resolution of the oxygen paradox. *Front Aging Neurosci.* 2010 Mar 18;2:10. doi:10.3389/fnagi.2010.00010.
- Hipkiss A. R.* Mitochondrial dysfunction, proteotoxicity, and aging: causes or effects, and the possible impact of NAD⁺-controlled protein glycation. *Adv Clin Chem.* 2010;50:123–50.
- Ho J. K., Duclos R. I. Jr, Hamilton J. A.* Interactions of acyl carnitines with model membranes: a (13) C-NMR study. *J Lipid Res.* 2002 Sep; 43(9):1429–39. doi:10.1194/jlr.M200137-JLR200.
- Kelley D. E., Mandarino L. J.* Fuel selection in human skeletal muscle in insulin resistance: a reexamination. *Diabetes.* 2000 May; 49(5):677–83. doi:10.2337/diabetes.49.5.677.
- Kelley D. E., Simoneau J. A.* Impaired free fatty acid utilization by skeletal muscle in noninsulin-dependent diabetes mellitus. *J Clin Invest.* 1994 Dec; 94(6):2349–56. doi:10.1172/JCI117600.

Kil I. S., et al. Glycation-induced inactivation of NADP(+)-dependent isocitrate dehydrogenase: implications for diabetes and aging. *Free Radic Biol Med.* 2004 Dec 1; 37(11):1765–78.

Li J. M., Shah A. M. Endothelial cell superoxide generation: regulation and relevance for cardiovascular pathophysiology. *Am J Physiol Regul Integr Comp Physiol.* 2004 Nov; 287(5):R1014–R1030. doi:10.1152/ajp-regu.00124.2004.

Lin J., et al. Transcriptional co-activator PGC-1 alpha drives the formation of slow-twitch muscle fibres. *Nature.* 2002 Aug 15; 418(6899):797–801. doi:10.1038/nature00904.

Lindroos M. M., et al. m.3243A>G mutation in mitochondrial DNA leads to decreased insulin sensitivity in skeletal muscle and to progressive {beta}-cell dysfunction. *Diabetes.* 2009 Mar; 58(3):543–9. doi:10.2337/db08-0981.

Linnane A. W., Kovalenko S., Gingold E. B. The universality of bioenergetic disease. Age-associated cellular bioenergetic degradation and amelioration therapy. *Ann NY Acad Sci.* 1998 Nov 20; 854:202–13. doi:10.1111/j.1749-6632.1998.tb09903.x.

Maassen J. A. Mitochondria, body fat and type 2 diabetes: what is the connection? *Minerva Med.* 2008 Jun; 99(3):241–51.

Maassen J. A., et al. Mitochondrial diabetes: molecular mechanisms and clinical presentation. *Diabetes.* 2004 Feb; 53 Suppl 1:S103–S109. doi:0.2337/diabetes.53.2007.S103.

Maassen J. A., et al. Mitochondrial diabetes and its lessons for common type 2 diabetes. *Biochem Soc Trans.* 2006; 34:819–23.

Morino K., et al. Reduced mitochondrial density and increased IRS-1 serine phosphorylation in muscle of insulin-resistant offspring of type 2 diabetic parents. *J Clin Invest.* 2005 Dec 1; 115(12):3587–93. doi:10.1172/JCI25151.

Patti M. E., et al. Coordinated reduction of genes of oxidative metabolism in humans with insulin resistance and diabetes: potential role of PGC1 and NRF1. *Proc Natl Acad Sci U S A.* 2003 Jul 8; 100(14):8466–71. Epub 2003 Jun 27. doi:10.1073/pnas.1032913100.

Petersen K. F., et al. Mitochondrial dysfunction in the elderly: possible role in insulin resistance. *Science.* 2003 May 16; 300(5622):1140–2. doi:10.1126/science.1082889.

Ritov V. B., et al. Deficiency of subsarcolemmal mitochondria in obesity and type 2 diabetes. *Diabetes*. 2005 Jan; 54(1):8–14. doi:10.2337/diabetes.54.1.8.

Rocha M., et al. Mitochondrial dysfunction and oxidative stress in insulin resistance. *Curr Pharm Des*. 2013; 19(32):5730–41. Epub Feb 20 2013.

Rocha M., et al. Perspectives and potential applications of mitochondria-targeted antioxidants in cardiometabolic diseases and type 2 diabetes. *Med Res Rev*. 2014 Jan; 34(1):160–89. Epub 2013 May 3. doi:10.1002/med.21285.

Rovira-Llopis S., et al. Mitochondrial dynamics in type 2 diabetes: pathophysiological implications. *Redox Biology*. 2017 Apr; 11:637–45. doi:10.1016/j.redox.2017.01.013.

Ryu M. J. et al. Crif1 deficiency reduces adipose OXPHOS capacity and triggers inflammation and insulin resistance in mice. *PLoS Genet*. 2013 Mar; 9(3):e1003356. Epub 2013 Mar 14. doi:10.1371/journal.pgen.1003356.

Schrauwen P., et al. Uncoupling protein 3 content is decreased in skeletal muscle of patients with type 2 diabetes. *Diabetes*. 2001 Dec 1; 50(12):2870–3. doi:10.2337/diabetes.50.12.2870.

Schrauwen P., Hesselink M. K. Oxidative capacity, lipotoxicity, and mitochondrial damage in type 2 diabetes. *Diabetes*. 2004 Jun; 53(6):1412–7. doi:10.2337/diabetes.53.6.1412.

Short K. R., et al. Decline in skeletal muscle mitochondrial function with aging in humans. *Proc Natl Acad Sci U S A*. 2005 Apr 12; 102(15):5618–23. doi:10.1073/pnas.0501559102.

Suwa M., et al. Metformin increases the PGC-1alpha protein and oxidative enzyme activities possibly via AMPK phosphorylation in skeletal muscle in vivo. *J Appl Physiol (1985)*. 2006 Dec; 101(6):1685–92. doi:10.1152/jappphysiol.00255.2006.

Takahashi Y., et al. Hepatic failure and enhanced oxidative stress in mitochondrial diabetes. *Endocr J*. 2008 Jul; 55(3):509–14. doi:10.1507/endocrj.K07E-091.

UK Prospective Diabetes Study Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). *Lancet*. 1998 Sep 12; 352(9131):837–53. doi:10.1016/S0140-6736(98)07019-6.

Vanhorebeek I., et al. Tissue-specific glucose toxicity induces mitochondrial damage in a burn injury model of critical illness. *Crit Care Med.* 2009 Apr; 37(4):1355–64. doi:10.1097/CCM.0b013e31819cec17.

Vidal-Puig A. J., et al. Energy metabolism in uncoupling protein 3 gene knockout mice. *J Biol Chem.* 2000 May 26; 275(21):16258–66. doi:10.1074/jbc.M910179199.

Wang X. et al. Protective effect of oleanolic acid against beta cell dysfunction and mitochondrial apoptosis: crucial role of ERK-NRF2 signaling pathway. *J Biol Regul Homeost Agents.* 2013 Jan–Mar; 27(1):55–67.

Weksler-Zangen S., et al. Dietary copper supplementation restores α -cell function of Cohen diabetic rats: a link between mitochondrial function and glucose stimulated insulin secretion. *Am J Physiol Endocrinol Metab.* 2013 May 15; 304(10):E1023–E1034. Epub 2013 Mar 19. doi:10.1152/ajpendo.00036.2013.

Winder W. W., Hardie D. G. AMP-activated protein kinase, a metabolic master switch: possible roles in type 2 diabetes. *Am J Physiol.* 1999 Jul; 277(1 Pt 1):E1–E10.

Yan W., et al. Impaired mitochondrial biogenesis due to dysfunctional adiponectin AMPKPGC-1 α signaling contributing to increased vulnerability in diabetic heart. *Basic Res Cardiol.* 2013 May;108(3):329. Epub 2013 Mar 5. doi:10.1007/s00395-013-0329-1.

Ye J. Mechanisms of insulin resistance in obesity. *Front Med.* 2013 Mar; 7(1):14–24. Epub 2013 Mar 9. doi:10.1007/s11684-013-0262-6.

Индукцированные приемом лекарств повреждения митохондрий и соответствующие болезни

Abdoli N., et al. Mechanisms of the statins' cytotoxicity in freshly isolated rat hepatocytes. *J Biochem Mol Toxicol.* 2013 Jun; 27(6):287–94. Epub 2013 Apr 23. doi:10.1002/jbt.21485.

Anedda A., Rial E., González-Barroso M. M. Metformin induces oxidative stress in white adipocytes and raises uncoupling protein 2 levels. *J Endocrinol.* 2008 Oct; 199(1):33–40. Epub 2008 Aug 7. doi:10.1677/JOE-08-0278.

Balijepalli S., Boyd M. R., Ravindranath V. Inhibition of mitochondrial complex I by haloperidol: the role of thiol oxidation. *Neuropharmacology*. 1999 Apr; 38(4):567–77. doi:10.1016/S0028-3908(98)00215-9.

Balijepalli S., et al. Protein thiol oxidation by haloperidol results in inhibition of mitochondrial complex I in brain regions: comparison with atypical antipsychotics. *Neurochem Int*. 2001, 38, 425–35. doi:10.1016/S0197-0186(00)00108-X.

Beavis A. D. On the inhibition of the mitochondrial inner membrane anion uniporter by cationic amphiphiles and other drugs. *J Biol Chem*. 1989 Jan 25; 264:1508–15.

Belenky P., Camacho D., Collins J. J. Fungicidal drugs induce a common oxidative-damage cellular death pathway. *Cell Rep*. 2013 Feb 21; 3(2):350–8. Epub 2013 Feb 14. doi:10.1016/j.celrep.2012.12.021.

Berson A., et al. Steatohepatitis-inducing drugs cause mitochondrial dysfunction and lipid peroxidation in rat hepatocytes. *Gastroenterology*. 1998 Apr; 114(4):764–74. doi:10.1016/S0016-5085(98)70590-6.

Brinkman K., et al. Mitochondrial toxicity induced by nucleoside-analogue reverse transcriptase inhibitors is a key factor in the pathogenesis of antiretroviral-therapy-related lipodystrophy. *Lancet*. 1999 Sep 25; 354(9184):1112–5. doi:10.1016/S0140-6736(99)06102-4.

Brinkman K., Kakuda T. N. Mitochondrial toxicity of nucleoside analogue reverse transcriptase inhibitors: a looming obstacle for long-term antiretroviral therapy? *Curr Opin Infect Dis*. 2000 Feb; 13(1):5–11.

Brown S. J., Desmond P. V. Hepatotoxicity of antimicrobial agents. *Sem Liver Dis*. 2002; 22(2): 157–67. doi:10.1055/s-2002-30103.

Carvalho F. S., et al. Doxorubicin-induced cardiotoxicity: from bioenergetic failure and cell death to cardiomyopathy. *Med Res Rev*. 2014 Jan; 34(1):106–35. Epub 2013 Mar 11. doi:10.1002/med.21280.

Chan K., et al. Drug induced mitochondrial toxicity. *Expert Opin Drug Metab Toxicol*. 2005 Dec; 1(4):655–69. doi:10.1517/17425255.1.4.655.

Chen Y., et al. Antidiabetic drug metformin (GlucophageR) increases biogenesis of Alzheimer's amyloid peptides via up-regulating BACE1 transcription. *Proc Natl Acad Sci U S A*. 2009 Mar 10; 106(10):3907–12. doi:10.1073/pnas.0807991106.

Chitturi S. M. D, George J. P. D. Hepatotoxicity of commonly used drugs: nonsteroidal antiinflammatory drugs, antihypertensives, antidiabetic agents, anticonvulsants, lipid lowering agents, psychotropic drugs. *Semin Liver Dis.* 2002; 22(2):169–83. doi:10.1055/s-2002-30102.

Chrysant S. G. New onset diabetes mellitus induced by statins: current evidence. *Postgrad Med.* 2017 May; 129(4):430–5. Epub 2017 Feb 24. doi:10.1080/00325481.2017.1292107.

Cullen J. M. Mechanistic classification of liver injury. *Toxicol Pathol.* 2005; 33(1):6–8. doi:10.1080 /01926230590522428.

Dong H., et al. Involvement of human cytochrome P450 2D6 in the bioactivation of acetaminophen. *Drug Metab. Dispos.* 2000 Dec; 28(12):1397–400.

Dykens J. A., Will Y. The significance of mitochondrial toxicity testing in drug development. *Drug Discov Today.* 2007 Sep; 12(17–18):777–85. doi:10.1016/j.drudis.2007.07.013.

Ezoulin M. J., et al. Differential effect of PMS777, a new type of acetylcholinesterase inhibitor, and galanthamine on oxidative injury induced in human neuroblastoma SK-N-SH cells. *Neurosci Lett.* 2005 Dec 2; 389(2):61–5. doi:10.1016/j.neulet.2005.07.026.

Fromenty B., Pessayre D. Impaired mitochondrial function in microvesicular steatosis effects of drugs, ethanol, hormones and cytokines. *J Hepatol.* 1997; 26 Suppl 2:43–53. doi:10.1016 /S0168-8278(97)80496-5.

Gambelli S., et al. Mitochondrial alterations in muscle biopsies of patients on statin therapy. *J. Submicrosc Cytol Pathol.* 2004; 36(1):85–9.

Gvozdjakova A., et al. Coenzyme Q10 supplementation reduces corticosteroids dosage in patients with bronchial asthma. *Biofactors.* 2005; 25(1–4):235–40. doi:10.1002/biof .5520250129.

Han D., et al. Regulation of drug-induced liver injury by signal transduction pathways: critical role of mitochondria. *Trends Pharmacol Sci.* 2013 Apr; 34(4):243–53. Epub 2013 Feb 27. doi:10.1016/j.tips.2013.01.009.

Jaeschke H., Bajt M. L. Intracellular signaling mechanisms of acetaminophen-induced liver cell death. *Toxicol Sci.* 2006 Jan; 89(1):31–41. doi:10.1093/toxsci/kfi336.

Kalghatgi S., et al. Bactericidal antibiotics induce mitochondrial dysfunction and oxidative damage in mammalian cells. *Sci Transl Med.* 2013 Jul 3; 5(192):192ra85. doi:10.1126 /scitranslmed.3006055.

Lambert P., et al. Chronic lithium treatment decreases neuronal activity in the nucleus accumbens and cingulate cortex of the rat. *Neuropsychopharmacology.* 1999; 21:229–37. doi:10.1016/S0893-133X(98)00117-1.

Lee W. M. Acetaminophen and the US acute liver failure study group: lowering the risks of hepatic failure. *Hepatology.* 2004 Jul; 40(1):6–9. doi:10.1002/hep.20293.

Levy H. B., Kohlhaas H. K. Considerations for supplementing with coenzyme Q10 during statin therapy. *Ann Pharmacother.* 2006 Feb; 40(2):290–4. doi:10.1345/aph.1G409.

Mansouri A., et al. Tacrine inhibits topoisomerases and DNA synthesis to cause mitochondrial DNA depletion and apoptosis in mouse liver. *Hepatology.* 2003 Sep; 38(3):715–25. doi:10.1053/jhep.2003.50353.

Masubuchi Y., Suda C., Horie T. Involvement of mitochondrial permeability transition in acetaminophen-induced liver injury in mice. *J Hepatol.* 2005 Jan; 42(1):110–6. doi:10.1016 /j.jhep.2004.09.015.

Maurer I., Moller H. J. Inhibition of complex I by neuroleptics in normal human brain cortex parallels the extrapyramidal toxicity of neuroleptics. *Mol Cell Biochem.* 1997 Sep; 174(1–2):255–9.

Mikus C. R., et al. Simvastatin impairs exercise training adaptations. *J Am Coll Cardiol.* 2013 Aug 20; 62(8):709–14. Epub 2013 Apr 10. doi:10.1016/j.jacc.2013.02.074.

Modica-Napolitano J. S., et al. Differential effects of typical and atypical neuroleptics on mitochondrial function in vitro. *Arch Pharm Res.* 2003 Nov; 26(11):951–9.

Mohamed T. M., Ghaffar H. M., El Husseiny R. M. Effects of tramadol, clonazepam, and their combination on brain mitochondrial complexes. *Toxicol Ind Health.* 2015 Dec; 31(12): 1325–33. Epub 2013 Jul 10. doi:10.1177/0748233713491814.

Musavi S., Kakkar P. Diazepam induced early oxidative changes at the subcellular level in rat brain. *Mol Cell Biochem.* 1998 Jan; 178(1–2):41–6.

Neustadt J., Pieczenik S. R. Medication-induced mitochondrial damage and disease. *Mol Nutr Food Res.* 2008 Jul; 52(7):780–8. doi:10.1002/mnfr.200700075.

Olsen E. A., Brambrink A. M. Anesthetic neurotoxicity in the newborn and infant. *Curr Opin Anaesthesiol.* 2013 Oct; 26(5):535–42. Epub 2013 Aug 29. doi:10.1097/01.aco.0000433061.59939.b7.

Reid A. B., et al. Mechanisms of acetaminophen-induced hepatotoxicity: role of oxidative stress and mitochondrial permeability transition in freshly isolated mouse hepatocytes. *J Pharmacol Exp Ther.* 2005 Feb; 312(2):509–16. doi:10.1124/jpet.104.075945.

Robertson A. M., Ferguson L. R., Cooper G. J. Biochemical evidence that high concentrations of the antidepressant amoxapine may cause inhibition of mitochondrial electron transport. *Toxicol Appl Pharmacol.* 1988 Mar 30; 93(1):118–26. doi:10.1016/0041-008X(88)90031-2.

Shah N. L., Gordon F. D. N-acetylcysteine for acetaminophen overdose: when enough is enough. *Hepatology.* 2007 Sep; 46(3):939–41.

Sirvent P., et al. Simvastatin induces impairment in skeletal muscle while heart is protected. *Biochem Biophys Res Commun.* 2005 Dec 23; 338(3):1426–34. doi:10.1016/j.bbrc.2005.10.108.

Sirvent P., et al. Simvastatin triggers mitochondria-induced Ca²⁺ signaling alteration in skeletal muscle. *Biochem Biophys Res Commun.* 2005 Apr 15; 329(3):1067–75. doi:10.1016/j.bbrc.2005.02.070.

Souza M. E., et al. Effect of fluoxetine on rat liver mitochondria. *Biochem Pharmacol.* 1994 Aug 3; 48(3):535–41. doi:10.1016/0006-2952(94)90283-6.

Vaughan R. A., et al. Ubiquinol rescues simvastatin-suppression of mitochondrial content, function and metabolism: implications for statin-induced rhabdomyolysis. *Eur J Pharmacol.* 2013 Jul 5; 711(1–3):1–9. Epub 2013 Apr 24. doi:10.1016/j.ejphar.2013.04.009.

Velho J. A., et al. Statins induce calcium-dependent mitochondrial permeability transition. *Toxicology.* 2006 Feb; 219(1–3):124–32.

Wang M. Y., Sadun A. A. Drug-related mitochondrial optic neuropathies. *J Neuroophthalmol.* 2013 Jun; 33(2):172–8. doi:10.1097/WNO.0b013e3182901969.

Westwood F. R., et al. Statin-induced muscle necrosis in the rat: distribution, development, and fibre selectivity. *Toxicol Pathol.* 2005; 33(2):246–57. doi:10.1080/01926230590908213.

Xia Z., et al. Changes in the generation of reactive oxygen species and in mitochondrial membrane potential during apoptosis induced by the antidepressants imipramine, clomipramine, and citalopram and the effects on these changes by Bcl-2 and BclX(L). *Biochem Pharmacol.* 1999 May 15; 57(10):1199–208.

Xue S. Y., et al. Nucleoside reverse transcriptase inhibitors induce a mitophagy-associated endothelial cytotoxicity that is reversed by coenzyme Q10 cotreatment. *Toxicol Sci.* 2013 Aug;134(2):323–34. Epub 2013 May 2. doi:10.1093/toxsci/kft105.

Yousif W. Microscopic studies on the effect of alprazolam (Xanax) on the liver of mice. *Pak J Biol Sci.* 2002; 5(11):1220–5. doi:10.3923/pjbs.2002.1220.1225.

Zhao C., Shichi H. Prevention of acetaminophen-induced cataract by a combination of diallyl disulfide and N-acetylcysteine. *J Ocul Pharmacol Ther.* 1998 Aug; 14(4):345–55. doi:10.1089 /jop.1998.14.345.

Митохондриальный синдром

Bainbridge, L. Understanding and coping with mitochondrial disease. Hamilton, ON: Hamilton Health Sciences; 2010.

Bertini E., D'Amico A. Mitochondrial encephalomyopathies and related syndromes [review]. *Endocr Dev.* 2009; 14:38–52.

Debray F. G., Lambert M., Mitchell G. A. Disorders of mitochondrial function. *Curr Opin Pediatr.* 2008 Aug; 20(4):471–82. doi:10.1097/MOP.0b013e328306ebb6.

DiMauro S., Schon E. A. Mitochondrial respiratory-chain diseases. *N Engl J Med.* 2003 Jun; 348(26):2656–68. doi:10.1056/NEJMra022567.

DiMauro S., et al. Diseases of oxidative phosphorylation due to mtDNA mutations. *Semin Neurol.* 2001 Sep; 21(3):251–60. doi:10.1055/s-2001-17942.

Finsterer J. Leigh and Leigh-like syndrome in children and adults. *Pediatr Neurol.* 2008 Oct; 39(4):223–35. doi:10.1016/j.pediatrneurol.2008.07.013.

Folkers K., Simonsen R. Two successful double-blind trials with coenzyme Q10 (vitamin Q10) on muscular dystrophies and neurogenic atrophies. *Biochim Biophys Acta.* 1995 May 24; 1271(1):281–6.

Goldstein A. C., Bhatia P., Vento J. M. Mitochondrial disease in childhood: nuclear encoded. *Neuro-therapeutics.* 2013 Apr; 10(2):212–26. Epub Mar 21 2013. doi:10.1007/s13311-013-0185-6.

Kisler J. E., Whittaker R. G., McFarland R. Mitochondrial diseases in childhood: a clinical approach to investigation and management. *Dev Med Child Neurol.* 2010 May; 52(5):422–33. doi:10.1111/j.1469-8749.2009.03605.x.

Koenig M. K. Presentation and diagnosis of mitochondrial disorders in children. *Pediatr Neurol.* 2008 May; 38(5):305–13. doi:10.1016/j.pediatr-neurol.2007.12.001.

Li H., et al. Comparative bioenergetic study of neuronal and muscle mitochondria during aging. *Free Radic Biol Med.* 2013 Oct; 63:30–40. Epub Apr 30 2013. doi:10.1016/j.freeradbiomed.2013.04.030.

Lodi R., et al. Antioxidant treatment improves in vivo cardiac and skeletal muscle bioenergetics in patients with Friedreich's ataxia. *Ann Neurol.* 2001 May 1; 49(5):590–6. doi:10.1002/ana.1001.

McFarland R., Taylor R. W., Turnbull D. M. A neurological perspective on mitochondrial disease. *Lancet Neurol.* 2010 Aug; 9(8):829–840. doi:10.1016/S1474-4422(10)70116-2.

Siciliano G., et al. Functional diagnostics in mitochondrial diseases. *Biosci Rep.* 2007 Jun; 27(1–3):53–67. doi:10.1007/s10540-007-9037-0.

Sproule D. M., Kaufmann P. Mitochondrial encephalopathy, lactic acidosis, and strokelike episodes: basic concepts, clinical phenotype, and therapeutic management of MELAS syndrome. *Ann NY Acad Sci.* 2008 Oct; 1142:133–58. doi:10.1196/annals.1444.011.

Tarnopolsky M. A., Raha S. Mitochondrial myopathies: diagnosis, exercise intolerance, and treatment options. *Med Sci Sports Exerc.* 2005 Dec; 37(12):2086–93.

Taylor R. W., Turnbull D. M. Mitochondrial DNA mutations in human disease. *Nat Rev Genet.* 2005 May; 6(5):389–402. doi:10.1038/nrg1606.

Thorburn D. R. Mitochondrial disorders: prevalence, myths and advances. *J Inherit Metab Dis.* 2004; 27(3):349–62. doi:10.1023/B:BOLI.0000031098.41409.55.

Tuppen H. A., et al. Mitochondrial DNA mutations and human disease. *Biochim Biophys Acta.* 2010 Feb; 1797(2):113–28. doi:10.1016/j.bbabi.2009.09.005.

Uitto J., Bernstein E. F. Molecular mechanisms of cutaneous aging: connective tissue alterations in the dermis. *J Investig Dermatol Symp Proc.* 1998 Aug; 3(1):41–4.

Waller J. M., Maibach H. I. Age and skin structure and function, a quantitative approach (II): protein, glycosaminoglycan, water, and lipid content and structure. *Skin Res Technol.* 2006 Aug; 12(3):145–54. doi:10.1111/j.0909-752X.2006.00146.x.

Возрастная тугоухость

Bai U., et al. Mitochondrial DNA deletions associated with aging and possibly presbycusis: a human archival temporal bone study. *Am J Otol.* 1997 Jul;18(4):449–53.

Chen F. Q., et al. Mitochondrial peroxiredoxin 3 regulates sensory cell survival in the cochlea. *PLoS One.* 2013 Apr 23; 8(4):e61999. doi:10.1371/journal.pone.0061999.

Dahl H. H., et al. Etiology and audiological outcomes at 3 years for 364 children in Australia. *PLoS One.* 2013;8(3):e59624. Epub 2013 Mar 28. doi:10.1371/journal.pone.0059624.

Ding Y., et al. The role of mitochondrial DNA mutations in hearing loss. *Biochem Genet.* 2013 Aug;51(7–8):588–602. Epub Apr 21 2013. doi:10.1007/s10528-013-9589-6.

Granville D. J., Gottlieb R. A. Mitochondria: Regulators of cell death and survival. *Scientific World Journal.* 2002 Jun 11; 2:1569–78. doi:10.1100/tsw.2002.809.

Han C., Someya S. Maintaining good hearing: calorie restriction, Sirt3, and glutathione. *Exp Gerontol.* 2013 Oct 1; 48(10):1091–5. Epub 2013 Feb 20. doi:10.1016/j.exger.2013.02.014. Johnsson LG, Hawkins JE Jr. Vascular

changes in the human inner ear associated with aging. *Ann Otol Rhinol Laryngol.* 1972 Jun; 81(3):364–76. doi:10.1177/000348947208100307.

Komlosi K., et al. Non-syndromic hearing impairment in a Hungarian family with the m.7510T>C mutation of mitochondrial tRNA(Ser(UCN)) and review of published cases. *JIMD Rep.* 2013; 9:105–11. Epub 2012 Nov 2. doi:10.1007/8904_2012_187.

Lin F. R., et al. Hearing loss and cognitive decline in older adults. *JAMA Intern Med.* 2013; 173(4):293–9. doi:10.1001/jamainternmed.2013.1868.

Luo L. F., Hou C. C., Yang W. X. Nuclear factors: roles related to mitochondrial deafness. *Gene.* 2013 May 15;520(2):79–89. Epub 2013 Mar 17. doi:10.1016/j.gene.2013.03.041.

Miller J. M., Marks N. J., Goodwin P. C. Laser Doppler measurements of cochlear blood flow. *Hearing Res.* 1983 Sep;11(3):385–94.

Seidman M. D. Effects of dietary restriction and antioxidants on presbycusis. *Laryngoscope.* 2000 May;110(5 pt 1):727–38. doi:10.1097/00005537-200005000-00003.

Seidman M. D., et al. Age related differences in cochlear microcirculation and auditory brain stem responses. *Arch Otolaryngol Head Neck Surg.* 1996 Nov; 122(11):1221–6. doi:10.1001/archotol.1996.01890230067013.

Seidman M. D., et al. Mitochondrial DNA deletions associated with aging and presbycusis. *Arch Otolaryngol Head Neck Surg.* 1997 Oct; 123(10):1039–45.

Seidman M. D., et al. Biologic activity of mitochondrial metabolites on aging and age-related hearing loss. *Am J Otol.* 2000 Mar; 21(2):161–7.

Seidman M. D., Moneysmith M. Save your hearing now. New York: Warner Books; 2006.

Semsei I., Rao G., Richardson A. Changes in the expression of superoxide dismutase and catalase as a function of age and dietary restriction. *Biochem Biophys Res Commun.* 1989 Oct 31; 164(2):620–5. doi:10.1016/0006-291X(89)91505-2.

Wallace D. C. Mitochondrial genetics: a paradigm for aging and degenerative diseases? *Science.* 1992 May 1; 256(5057):628–32. doi:10.1126/science.1533953.

Yamasoba T., et al. Current concepts in age-related hearing loss: epidemiology and mechanistic pathways. *Hear Res.* 2013 Sep;303:30–8. Epub 2013 Feb 16. doi:10.1016/j.heares.2013.01.021.

Yelverton J. C., et al. The clinical and audiologic features of hearing loss due to mitochondrial mutations. *Otolaryngol Head Neck Surg.* 2013 Jun; 148(6):1017–22. Epub 2013 Mar 22. doi:10.1177/0194599813482705.

Митохондрии, старение кожи и морщины

Balin A. K., Pratt L. A. Physiological consequences of human skin aging. *Cutis.* 1989 May; 43(5):431–6.

Blatt T., et al. Stimulation of skin's energy metabolism provides multiple benefits for mature human skin. *Biofactors.* 2005; 25(1–4):179–85. doi:10.1002/biof.5520250121.

Greco M., et al. Marked aging-related decline in efficiency of oxidative phosphorylation in human skin fibroblasts. *FASEB J.* 2003 Sep;17(12):1706–8. doi:10.1096/fj.02-1009fje.

Kagan J., Srivastava S. Mitochondria as a target for early detection and diagnosis of cancer. *Crit Rev Clin Lab Sci.* 2008; 42(5–6):453–72. doi:10.1080/10408360500295477.

Kleszczynski K., Fischer T. W. Melatonin and human skin aging. *Dermatoendocrinol.* 2012 Jul 1; 4(3):245–52. doi:10.4161/derm.22344.

Kurban R. S., Bhawan J. Histologic changes in skin associated with aging. *J Dermatol Surg Oncol.* 1990 Oct; 16(10):908–14.

Navarro A., Boveris A. The mitochondrial energy transduction system and the aging process. *Am J Physiol Cell Physiol.* 2007 Feb; 292(2):C670–C686. Epub 2006 Oct 4. doi:10.1152 /ajpcell.00213.2006.

Passi S., et al. Lipophilic antioxidants in human sebum and aging. *Free Radic Res.* 2002 Apr; 36(4):471–7.

Passi S., et al. The combined use of oral and topical lipophilic antioxidants increases their levels both in sebum and stratum corneum. *Biofactors.* 2003; 18(1–4):289–97. doi:10.1002 /biof.5520180233.

Rusciani L., et al. Low plasma coenzyme Q10 levels as an independent prognostic factor for melanoma progression. *J Am Acad Dermatol.* 2006 Feb; 54(2):234–41. doi:10.1016 /j.jaad.2005.08.031.

Treiber N., et al. The role of manganese superoxide dismutase in skin aging. *Dermatoendocrinol.* 2012 Jul 1; 4(3):232–5. doi:10.4161/derm.21819.

Uitto J, Bernstein E. F. Molecular mechanisms of cutaneous aging: connective tissue alterations in the dermis. *J Investig Dermatol Symp Proc.* 1998 Aug;3(1):41–4.

Waller J. M., Maibach H. I. Age and skin structure and function, a quantitative approach (II): protein, glycosaminoglycan, water, and lipid content and structure. *Skin Res Technol.* 2006 Aug; 12(3):145–54. doi:10.1111/j.0909-752X.2006.00146.x.

Митохондрии и бесплодие

Al Rawi S., et al. Postfertilization autophagy of sperm organelles prevents paternal mitochondrial DNA transmission. *Science.* 2011 Nov 25; 334(6059):1144–7. Epub 2011 Oct 27. doi:10.1126/science.1211878.

Baylis F. The ethics of creating children with three genetic parents. *Reprod Biomed Online.* 2013 Jun; 26(6):531–4. Epub 2013 Mar 26. doi:10.1016/j.rbmo.2013.03.006.

Chappel S. The role of mitochondria from mature oocyte to viable blastocyst. *Obstet Gynecol Int.* 2013:1–10. Epub 2013 May 16. doi:10.1155/2013/183024.

Colagar A. H., et al. T4216C mutation in NADH dehydrogenase I gene is associated with recurrent pregnancy loss. *Mitochondrial DNA.* 2013 Oct; 24(5):610–2. Epub 2013 Mar 6. doi:10.3109/19401736.2013.772150.

Cotterill M., et al. The activity and copy number of mitochondrial DNA in ovine oocytes throughout oogenesis in vivo and during oocyte maturation in vitro. *Mol Hum Reprod.* 2013 Jul; 19(7):444–50. Epub 2013 Mar 5. doi:10.1093/molehr/gat013.

Eichenlaub-Ritter U. Oocyte aging and its cellular basis. *Int J Dev Biol.* 2012; 56(10–12):841–52. doi:10.1387/ijdb.120141ue.

Grindler N. M., Moley K. H. Maternal obesity, infertility and mitochondrial dysfunction: potential mechanisms emerging from mouse model systems. *Mol Hum Reprod.* 2013 Aug; 19(8): 486–94. Epub 2013 Apr 23. doi:10.1093/molehr/gat026.

Kang E., et al. Mitochondrial replacement in human oocytes carrying pathogenic mitochondrial DNA mutations. *Nature.* 2016 Dec 8;540(7632):270–5. doi:10.1038/nature20592.

Latorre-Pellicer A., et al. Mitochondrial and nuclear DNA matching shapes metabolism and healthy ageing. *Nature.* 2016 Jul 28; 535(7613):561–5. Epub 2016 Jul 6. doi:10.1038/nature 18618.

Pang W., et al. Low expression of Mfn2 is associated with mitochondrial damage and apoptosis in the placental villi of early unexplained miscarriage. *Placenta.* 2013 Jul; 34(7):613–8. Epub 2013 Apr 17. doi:10.1016/j.placenta.2013.03.013.

Sato M., Sato K. Degradation of paternal mitochondria by fertilization-triggered autophagy in *C. elegans* embryos. *Science.* 2011 Nov 25; 334(6059):1141–4. doi:10.1126/science.1210333.

Tillett T. Potential mechanism for PM10 effects on birth outcomes: in utero exposure linked to mitochondrial DNA damage. *Environ Health Perspect.* 2012 Sep; 120(9):A363. doi:10.1289 /ehp.120-a363b.

Zuccotti M., Redi C. A., Garagna S. Study an egg today to make an embryo tomorrow. *Int J Dev Biol.* 2012; 56(10–12):761–4. doi:10.1387/ijdb.130027mz.

Глазные болезни

Banerjee D., et al. Mitochondrial genome analysis of primary open angle glaucoma patients. *PLoS One.* 2013 Aug 5; 8(8):e70760. doi:10.1371/journal.pone.0070760.

Blasiak J., et al. Mitochondrial and nuclear DNA damage and repair in age-related macular degeneration. *Int J Mol Sci.* 2013 Feb;14(2):2996–3010. Epub 2013 Jan 31. doi:10.3390 /ijms14022996.

Chen S. D., Wang L., Zhang X. L. Neuroprotection in glaucoma: present and future. *Chin Med J (Engl).* 2013 Apr; 126(8):1567–77. doi:10.3760/cma.j.issn.0366-6999.20123565.

Ghiso J. A., et al. Alzheimer's disease and glaucoma: mechanistic similarities and differences. *J Glaucoma*. 2013 Jun–Jul; 22 Suppl 5:S36–S38. doi:10.1097/IJG.0b013e3182934af6.

Izzotti A., et al. Mitochondrial damage in the trabecular meshwork of patients with glaucoma. *Arch Ophthalmol*. 2010 Jun; 128(6):724–30. doi:10.1001/archophthalmol.2010.87.

Lee V., et al. Vitamin D rejuvenates aging eyes by reducing inflammation, clearing amyloid beta and improving visual function. *Neurobiol Aging*. 2012 Oct; 33(10):2382–9. Epub 2012 Jan 2. doi:10.1016/j.neurobiolaging.2011.

Wang M. Y., Sadun A. A. Drug-related mitochondrial optic neuropathies. *J Neuroophthalmol*. 2013 Jun; 33(2):172–8. doi:10.1097/WNO.0b013e3182901969.

Стволовым клеткам нужны здоровые митохондрии

Conboy I. M., Rando T. A. Aging, stem cells and tissue regeneration: lessons from muscle. *Cell Cycle*. 2005 Mar; 4(3):407–10. doi:10.4161/cc.4.3.1518.

Flynn J. M., Melov S. SOD2 in mitochondrial dysfunction and neurodegeneration. *Free Radic Biol Med*. 2013 Sep; 62:4–12. Epub May 29 2013. doi:10.1016/j.freeradbiomed.2013.05.027.

Garcia M. L., Fernandez A., Solas M. T. Mitochondria, motor neurons and aging. *J Neurol Sci*. 2013 Jul 15. Epub 2013 Apr 26. doi:10.1016/j.jns.2013.03.019.

Hosoe K., et al. Study on safety and bioavailability of ubiquinol (Kaneka QH) after single and 4-week multiple oral administration to healthy volunteers. *Regul Toxicol Pharmacol*. 2007 Feb; 47(1):19–28. doi:10.1016/j.yrtph.2006.07.001.

Katajisto P., et al. Stem cells. Asymmetric apportioning of aged mitochondria between daughter cells is required for stemness. *Science*. 2015 Apr 17; 348(6232):340–3. Epub 2015 Apr 2. doi:10.1126/science.1260384.

Sahin E., DePinho R. A. Linking functional decline of telomeres, mitochondria and stem cells during ageing. *Nature*. 2010 Mar 25; 464(7288):520–8. doi:10.1038/nature08982.

Онкологические заболевания: осознание причин приближает к их устранению

Adams J. S., Cory S. The Bcl-2 protein family: arbiters of cell survival. *Science*. 1998 Aug 28; 281(5318):1322–6.

Brown J. M. Tumor microenvironment and the response to anticancer therapy. *Cancer Biol Ther*. 2002 Sep–Oct; 1(5):453–8. doi:10.4161/cbt.1.5.157.

Bui T., Thompson C. B. Cancer's sweet tooth. *Cancer Cell*. 2006 Jun; 9(6):419–20. doi:10.1016/j.ccr.2006.05.012.

Carracedo A., Cantley L. C., Pandolfi P. P. Cancer metabolism: fatty acid oxidation in the limelight. *Nat Rev Cancer*. 2013 Apr; 13(4):227–32. Epub 2013 Feb 28. doi:10.1038/nrc3483.

Christofferson, T. Tripping over the truth: how the metabolic theory of cancer is overturning one of medicine's most entrenched paradigms. White River Junction, VT: Chelsea Green Publishing; 2017.

Dalla Via L., et al. Mitochondrial permeability transition as target of anticancer drugs. *Curr Pharm Des*. 2014; 20(2):223–44. Epub 2013 May 16.

Davila A. E., Zamorano P. Mitochondria and the evolutionary roots of cancer. *Phys Biol*. 2013 Apr; 10(2):026008. Epub 2013 Mar 22. doi:10.1088/1478-3975/10/2/026008.

DeBerardinis R. J., et al. Beyond aerobic glycolysis: transformed cells can engage in glutamine metabolism that exceeds the requirement for protein and nucleotide synthesis. *Proc Natl Acad Sci U S A*. 2007 Dec 4; 104(49):19345–50. doi:10.1073/pnas.0709747104.

DeBerardinis R. J., et al. The biology of cancer: metabolic reprogramming fuels cell growth and proliferation. *Cell Metab*. 2008 Jan; 7(1):11–20. doi:10.1016/j.cmet.2007.10.002.

Fantin V. R., St-Pierre J., Leder P. Attenuation of LDH-A expression uncovers a link between glycolysis, mitochondrial physiology, and tumor maintenance. *Cancer Cell*. 2006 Jun; 9(6):425–34. doi:10.1016/j.ccr.2006.04.023.

Gottfried E., et al. Tumor-derived lactic acid modulates dendritic cell activation and antigen expression. *Blood*. 2006 Mar 1; 107(5):2013–21. doi:10.1182/blood-2005-05-1795.

Gottlieb E., Tomlinson I. P. Mitochondrial tumour suppressors: a genetic and biochemical update. *Nat Rev Cancer*. 2005 Nov; 5(11):857–66. doi:10.1038/nrc1737.

He X., et al. Suppression of mitochondrial complex I influences cell metastatic properties. *PLoS One*. 2013 Apr 22; 8(4):e61677. doi:10.1371/journal.pone.0061677.

Hoang B. X., et al. Restoration of cellular energetic balance with L-carnitine in the neurobioenergetic approach for cancer prevention and treatment. *Med Hypotheses*. 2007; 69(2): 262–72. doi:10.1016/j.mehy.2006.11.049.

Hung W. Y., et al. Somatic mutations in mitochondrial genome and their potential roles in the progression of human gastric cancer. *Biochim Biophys Acta*. 2010 Mar; 1800(3):264–70. doi:10.1016/j.bbagen.2009.06.006.

Ishikawa K., et al. ROS-generating mitochondrial DNA mutations can regulate tumor cell metastasis. *Science*. 2008 May 2; 320(5876):661–4. doi:10.1126/science.1156906.

Kiebish M. A., et al. Cardioplipin and electron transport chain abnormalities in mouse brain tumor mitochondria: lipidomic evidence supporting the Warburg theory of cancer. *J Lipid Res*. 2008 Dec; 49(12):2545–66. doi:10.1194/jlr.M800319-JLR200.

Kroemer G., Pouyssegur J. Tumor cell metabolism: cancer's Achilles' heel. *Cancer Cell*. 2008 Jun; 13(6):472–82. doi:10.1016/j.ccr.2008.05.005.

Kulawiec M., Owens K. M., Singh K. K. Cancer cell mitochondria confer apoptosis resistance and promote metastasis. *Cancer Biol Ther*. 2009 Jul; 8(14):1378–85.

Ladiges W., et al. A mitochondrial view of aging, reactive oxygen species and metastatic cancer. *Aging Cell*. 2010 Aug; 9(4):462–5. doi:10.1111/j.1474-9726.2010.00579.x.

Lee H. C., Chang C. M., Chi C. W. Somatic mutations of mitochondrial DNA in aging and cancer progression. *Ageing Res Rev*. 2010 Nov; 9 Suppl 1:S47–S58. doi:10.1016/j.arr.2010.08.009.

Li X., et al. Targeting mitochondrial reactive oxygen species as novel therapy for inflammatory diseases and cancers. *J Hematol Oncol*. 2013 Feb 25; 6(1):19. Epub. doi:10.1186/1756-8722-6-19.

Lin C. C., et al. Loss of the respiratory enzyme citrate synthase directly links the Warburg effect to tumor malignancy. *Sci Rep.* 2012; 2:785. Epub 2012 Nov 8. doi:10.1038/srep00785.

Ma Y., et al. Mitochondrial dysfunction in human breast cancer cells and their transmitochondrial cybrids. *Biochim Biophys Acta.* 2010 Jan; 1797(1):29–37. doi:10.1016 /j.bbabbio.2009.07.008.

Modica-Napolitano J. S., Kulawiec M., Singh K. K. Mitochondria and human cancer. *Curr Mol Med.* 2007 Feb; 7(1):121–31. doi:10.2174/156652407779940495.

Nicolson G. L., Conklin K. A. Reversing mitochondrial dysfunction, fatigue and the adverse effects of chemotherapy of metastatic disease by molecular replacement therapy. *Clin Exp Metastasis.* 2008; 25(2):161–9. doi:10.1007/s10585-007-9129-z.

Ordys B. B., et al. The role of mitochondria in glioma pathophysiology. *Mol Neurobiol.* 2010 Aug; 42(1):64–75. doi:10.1007/s12035-010-8133-5.

Parr R., et al. Mitochondria and cancer. *Biomed Res Int.* 2013; 2013:763703:1–2. Epub 2013 Jan 30. doi:10.1155/2013/763703.

Peck B, Ferber E. C., Schulze A. Antagonism between FOXO and MYC regulates cellular powerhouse. *Front Oncol.* 2013 Apr 25; 3:96. doi:10.3389/fonc.2013.00096.

Pelicano H., et al. Mitochondrial respiration defects in cancer cells cause activation of Akt survival pathway through a redox-mediated mechanism. *J Cell Biol.* 2006 Dec 18; 175 (6):913–23. doi:10.1083/jcb.200512100.

Pratheeshkumar P., Thejass P., Kutan G. Diallyl disulfide induces caspase-dependent apoptosis via mitochondria-mediated intrinsic pathway in B16F-10 melanoma cells by up-regulating p53, caspase-3 and down-regulating pro-inflammatory cytokines and nuclear factor-kB mediated Bcl-2 activation. *J Environ Pathol Toxicol Oncol.* 2010; 29(2):113–25. doi:10.1080 /01635581.2012.721156.

Ralph S. J., et al. The causes of cancer revisited: “mitochondrial malignancy” and ROS-induced oncogenic transformation — why mitochondria are targets for cancer therapy. *Mol Aspects Med.* 2010 Apr; 31(2):145–70. doi:10.1016/j.mam.2010.02.008.

Ramos-Montoya A., et al. Pentose phosphate cycle oxidative and nonoxidative balance: a new vulnerable target for overcoming drug resistance in cancer. *Int J Cancer*. 2006 Dec 15; 119(12):2733–41. doi:10.1002/ijc.22227.

Ray S., Biswas S., Ray M. Similar nature of inhibition of mitochondrial respiration of heart tissue and malignant cells by methylglyoxal. A vital clue to understand the biochemical basis of malignancy. *Mol Cell Biochem*. 1997 Jun; 171(1–2):95–103.

Shidara Y., et al. Positive contribution of pathogenic mutations in the mitochondrial genome to the promotion of cancer by prevention from apoptosis. *Cancer Res*. 2005 Mar 1; 65(5): 1655–63. doi:10.1158/0008-5472.CAN-04-2012.

Singh K. K. Mitochondrial dysfunction is a common phenotype in aging and cancer. *Ann N Y Acad Sci*. 2004 Jun;1019: 260–4. doi:10.1196/annals.1297.043.

Sotgia F., Martinez-Outschoorn U. E., Lisanti M. P. Cancer metabolism: new validated targets for drug discovery. *Oncotarget*. 2013 Aug; 4(8):1309–16. Epub 2013 Jul 22. doi:10.18632/oncotarget.1182.

Walenta S., Mueller-Klieser W. F. Lactate: mirror and motor of tumor malignancy. *Semin Radiat Oncol*. 2004 Jul; 14(3):267–74. doi:10.1016/j.semradonc.2004.04.004.

Walenta S., et al. High lactate levels predict likelihood of metastases, tumor recurrence, and restricted patient survival in human cervical cancers. *Cancer Res*. 2000 Feb 15;60(4):916–21.

Wallace D. C. Mitochondria and cancer: Warburg addressed. *Cold Spring Harb Symp Quant Biol*. 2005;70:363–74. doi:10.1101/sqb.2005.70.035.

Warburg O. On the origin of cancer cells. *Science*. 1956 Feb 24; 123(3191):309–14. doi:10.1126/science.123.3191.309.

Wenzel U., Daniel H. Early and late apoptosis events in human transformed and nontransformed colonocytes are independent on intracellular acidification. *Cell Physiol Biochem*. 2004; 14 (1–2):65–76. doi:10.1159/000076928.

Wenzel U., Nickel A., Daniel H. Increased carnitine-dependent fatty acid uptake into mitochondria of human colon cancer cells induces apoptosis. *J Nutr.* 2005 Jun; 135(6):1510–4.

Wigfield S. M., et al. PDK-1 regulates lactate production in hypoxia and is associated with poor prognosis in head and neck squamous cancer. *Br J Cancer.* 2008 Jun 17; 98(12):1975–84. doi:10.1038/sj.bjc.6604356.

Старение как болезнь

Adachi K., et al. A deletion of mitochondrial DNA in murine doxorubicin-induced cardiotoxicity. *Biochem Biophys Res Comm.* 1993 Sep 15; 195(2):945–51. doi:10.1006/bbrc.1993.2135.

Adachi K., et al. Suppression of the hydrazine-induced formation of megamitochondria in the rat liver by coenzyme Q10. *Toxicol Pathol.* 1995 Nov 1; 23(6):667–76.

Arbustini E., et al. Mitochondrial DNA mutations and mitochondrial abnormalities in dilated cardiomyopathy. *Am J Pathol.* 1998 Nov; 153(5):1501–10. doi:10.1016/S0002-9440(10)65738-0.

Cellular nutrition for vitality and longevity. *Life Extension* [internet]. 2000 April [cited 2017 Aug]; 24–28. Available from: <http://www.lifeextension.com/magazine/2000/4/cover2/page-01>.

DiMauro S., et al. Mitochondria in neuromuscular disorders. *Biochim Biophys Acta.* 1998 Aug 10; 1366(1–2):199–210. doi:10.1016/S0005-2728(98)00113-3.

Esposito L. A., et al. Mitochondrial disease in mouse results in increased oxidative stress. *Proc Natl Acad Sci U S A.* 1999 Apr 27; 96(9):4820–5.

Fontaine E., Ichas F., Bernardi P. A ubiquinone-binding site regulates the mitochondrial permeability transition pore. *J Biol Chem.* 1998; 273:25734–40.

Fontaine E., et al. Regulation of the permeability transition pore in skeletal muscle mitochondria. Modulation by electron flow through the respiratory chain complex i. *J Biol Chem.* 1998 May 15; 273(20):12662–8.

Geromel V., et al. The consequences of a mild respiratory chain deficiency on substrate competitive oxidation in human mitochondria. *Biochem Biophys Res Comm.* 1997 Aug; 236:643–6.

Karbowski M., et al. Free radical-induced megamitochondria formation and apoptosis. *Free Radic Biol Med.* 1999 Feb; 26(3–4):396–409. doi:10.1016/S0891-5849(98)00209-3.

Kopsidas G., et al. An age-associated correlation between cellular bioenergy decline and mtDNA rearrangements in human skeletal muscle. *Mutat Res.* 1998 Oct 12; 421(1):27–36. doi:10.1016/S0027-5107(98)00150-X.

Kovalenko S. A., et al. Tissue-specific distribution of multiple mitochondrial DNA rearrangements during human aging. *Ann NY Acad Sci.* 1998 Nov 20;854:171–81.

Ku H. H., Brunk U. T., Sohal R. S. Relationship between mitochondrial superoxide and hydrogen peroxide production and longevity of mammalian species. *Free Radic Biol Med.* 1993 Dec; 15(6):621–7.

Lass A., Agarwal S., Sohal R. S. Mitochondrial ubiquinone homologues, superoxide radical generation, and longevity in different mammalian species. *J Biol Chem.* 1997 Aug 1; 272:19199–204. doi:10.1074/jbc.272.31.19199.

Lass A., Sohal R. S. Comparisons of coenzyme Q bound to mitochondrial membrane proteins among different mammalian species. *Free Radic Biol Med.* 1999; 27(1–2):220–6.

Linnane A. W., et al. Mitochondrial DNA mutations as an important contributor to aging and degenerative diseases. *Lancet.* 1989 Mar 25;1(8639):642–5. doi:10.1016/S0140-6736(89)92145-4.

Linnane A. W., et al. The universality of bioenergetic disease and amelioration with redox therapy. *Biochim Biophys Acta.* 1995 May 24; 1271(1):191–4. doi:10.1016/0925-4439(95)00027-2.

Linnane A. W., Kovalenko S., Gingold E. B. The universality of bioenergetic disease. Age-associated cellular bioenergetic degradation and amelioration therapy. *Ann N Y Acad Sci.* 1998 Nov 20; 854:202–13. doi:10.1111/j.1749-6632.1998.tb09903.x.

Martinucci S., et al. Ca²⁺-reversible inhibition of the mitochondrial megachannel by ubiquinone analogues. *FEBS Lett.* 2000 Sep;480:89–94. doi:10.1016/S0014-5793(00)01911-6.

Michikawa Y., et al. Aging-dependent large accumulation of point mutations in the human mtDNA control region for replication. *Science.* 1999 Oct 22; 286(5440):774–9. doi:10.1126 /science.286.5440.774.

Ozawa T. Genetic and functional changes in mitochondria associated with aging. *Physiol Rev.* 1997 Apr; 77(2):425–64.

Richter C., et al. Control of apoptosis by the cellular ATP level. 1996 Jan 8; *FEBS Lett* 378(2): 107–10. doi:10.1016/0014-5793(95)01431-4.

Rosenfeldt F. L., et al. Coenzyme Q10 in vitro normalizes impaired post-ischemic contractile recovery of aged human myocardium. Fifth China International Congress on TCVS; 2000 September; Beijing, China.

Rosenfeldt F. L., et al. Response of the human myocardium to hypoxia and ischemia declines with age: correlations with increased mitochondrial DNA deletions. *Ann N Y Acad Sci.* 1998 Nov; 854:489–90. doi:10.1111/j.1749-6632.1998.tb09938.x.

Rowland M. A., et al. Coenzyme Q10 treatment improves the tolerance of the senescent myocardium to pacing stress in the rat. *Cardiovasc Res.* 1998 Oct; 40(1):165–73.

Sohal R. S., Sohal B. H., Orr W. C. Mitochondrial superoxide and hydrogen peroxide generation, protein oxidative damage, and longevity in different species of flies. *Free Radic Biol Med.* 1995 Oct; 19(4):499–504. doi:10.1016/0891-5849(95)00037-X.

Susin S. A., et al. Mitochondria as regulators of apoptosis: doubt no more. *Biochim Biophys Acta.* 1998 Aug 10; 1366(1–2):151–65. doi:10.1016/S0005-2728(98)00110-8.

Turker M. S. Somatic cell mutations: can they provide a link between aging and cancer? *Mech Aging Dev.* 2000 Aug 15; 117(1–3):1–19. doi:10.1016/S0047-6374(00)00133-0.

Wallace D. C. Mitochondrial diseases in man and mouse. *Science.* 1999 Mar 5; 283(5407): 1482–8. doi:10.1126/science.283.5407.1482.

Wallace D. C., et al. Mitochondrial DNA mutations in human degenerative diseases and aging. *Biochim Biophys Acta.* 1995 May 24; 1271(1):141–51. doi:10.1016/0925-4439(95)00021-U.

Walter L., et al. Three classes of ubiquinone analogs regulate the mitochondrial permeability transition pore through a common site. *J Biol Chem.* 2000 July 10; 275:29521–7. doi:10.1074 /jbc.M004128200.

Wei Y. H. Oxidative stress and mitochondrial DNA mutations in human aging. *Proc Soc Exp Biol Med.* 1998 Jan; 217(1):53–63.

Wei Y. H., Kao S. H., Lee H. C. Simultaneous increase of mitochondrial DNA deletions and lipid peroxidation in human aging. *Ann NY Acad Sci.* 1996 Jun 15; 786:24–43. doi:10.1111/j.1749-6632.1996.tb39049.x.

Wolvetang E. J., et al. Mitochondrial respiratory chain inhibitors induce apoptosis. 1994 Feb 14; 339(1–2):40–4. doi:10.1016/0014-5793(94)80380-3.

Zhang C., et al. Varied prevalence of age-associated mitochondrial DNA deletions in different species and tissues: a comparison between human and rat. *Biochem Biophys Res Comm.* 1997 Jan; 230(3):630–5. doi:10.1006/bbrc.1996.6020.

Глава 3

Ames B. N., Atamna H., Killilea D. W. Mineral and vitamin deficiencies can accelerate the mitochondrial decay of aging. *Mol Aspects Med.* 2005 Aug–Oct; 26(4–5):363–78. doi:10.1016/j.mam.2005.07.007.

Aw T. Y., Jones D. P. Nutrient supply and mitochondrial function. *Annu Rev Nutr.* 1989 Jul; 9:229–51. doi:10.1146/annurev.nu.09.070189.001305.

Williams K. L., et al. Differing effects of metformin on glycemic control by race-ethnicity. *J Clin Endocrinol Metab.* 2014 Sep; 99(9):3160–8. Epub 2014 June 12. doi:10.1210/jc.2014-1539.

D-рибоза

Andreoli S. P. Mechanisms of endothelial cell ATP depletion after oxidant injury. *Pediatr Res.* 1989 Jan; 25(1):97–101. doi:10.1203/00006450-198901000-00021.

Asimakis G., et al. Postischemic recovery of mitochondrial adenine nucleotides in the heart. *Circulation.* 1992 Jul; 85(6):2212–20.

Baldwin D., et al. Myocardial glucose metabolism and ATP levels are decreased two days after global ischemia. *J Surg Res.* 1996 Jun; 63(1):35–8. doi:10.1006/jsre.1996.0218.

Befera N., et al. Ribose treatment preserves function of the remote myocardium after myocardial infarction. *J Surg Res.* 2007 Feb; 137(2):156. doi:10.1016/j.jss.2006.12.022.

Bengtsson A., Heriksson K.G., Larsson J. Reduced high-energy phosphate levels in the painful muscles of patients with primary fibromyalgia. *Arth Rheum.* 1986 Jul; 29(7):817–21. doi:10.1002/art.1780290701.

Bengtsson A., Henriksson K. G. The muscle in fibromyalgia—a review of Swedish studies. *J Rheumatol Suppl.* 1989 Nov; 19:144–9.

Braut J. J., Terjung R. L. Purine salvage to adenine nucleotides in different skeletal muscle fiber types. *J Appl Physiol.* 2001; 91:231–8.

Chatham J. C., et al. Studies of the protective effect of ribose in myocardial ischaemia by using ³¹P-nuclear magnetic resonance spectroscopy. *Biochem Soc Proc.* 1985 Oct; 13(5):885–8. doi:10.1042/bst0130885.

Clay M. A., et al. Chronic alcoholic cardiomyopathy. Protection of the isolated ischemic working heart by ribose. *Biochem Int.* 1988 Nov; 17(5):791–800.

Dodd S. L., et al. The role of ribose in human skeletal muscle metabolism. *Med Hypotheses.* 2004; 62(5):819–24. doi:10.1016/j.mehy.2003.10.026.

Dow J., et al. Adenine nucleotide synthesis de novo in mature rat cardiac myocytes. *Biochim Biophys Acta.* 1985 Nov 20; 847(2):223–7. doi:10.1016/0167-4889(85)90024-2.

Ellison G. M., et al. Physiological cardiac remodelling in response to endurance exercise training: cellular and molecular mechanisms. *Heart (British Cardiac Society).* 2012 Jan; 98(1):5–10.

Enzig S., et al. Myocardial ATP repletion with ribose infusion. *Pediatr Res.* 1985; 19:127A.

Gebhart B., Jorgenson J. A. Benefit of ribose in a patient with fibromyalgia. *Pharmacotherapy.* 2004 Nov; 24(11):1646–8. doi:10.1592/phco.24.16.1646.50957.

Gross M., Kormann B., Zollner N. Ribose administration during exercise: effects on substrates and products of energy metabolism in healthy subjects and a patient with myoadenylate deaminase deficiency. *Klin Wochenschr.* 1991; 69(4):151–5.

Harmsen E., et al. Enhanced ATP and GTP synthesis from hypoxanthine or inosine after myocardial ischemia. *Am J Physiol.* 1984 Jan; 246(1 Pt 2): H37–H43.

Hass G. S., et al. Reduction of postischemic myocardial dysfunction by substrate repletion during reperfusion. *Circulation.* 1984 Sep; 70(3 Pt 2):165–74.

Hellsten Y., Skadhaug L., Bangsbo J. Effect of ribose supplementation on resynthesis of nucleotides after intense intermittent training in humans. *Am J Physiol.* 2004 Jan 1; 286(1): R182–R188. doi:10.1152/ajp-regu.00286.2003.

Ibel H., Zimmer H. G. Metabolic recovery following temporary regional myocardial ischemia in the rat. *J Mol Cell Cardiol.* 1986; 18(Suppl 4):61–5.

Ingwall J. S., Weiss R. G. Is the failing heart energy starved? On using chemical energy to support cardiac function. *Circ Res.* 2004 Jul 23; 95(2):135–45. doi:10.1161/01.RES.0000137170.41939.d9.

LaNoue K. F., Watts J. A., Koch C. D. Adenine nucleotide transport during cardiac ischemia. *Am J Physiol.* 1981 Nov; 241(5):H663–H671.

Lund N., Bengtsson A., Thorborg P. Muscle tissue oxygen in primary fibromyalgia. *Scan J Rheumatol.* 1986; 15(2):165–73. doi:10.3109/03009748609102084.

Mahoney J. R. Jr. Recovery of postischemic myocardial ATP levels and hexosemonophosphate shunt activity. *Med Hypoth.* 1990 Jan; 31(1):21–3. doi:10.1016/0306-9877(90)90047-I.

Maron B. J., Pelliccia A. The heart of trained athletes: cardiac remodeling and the risks of sports, including sudden death. *Circulation.* 2006 Oct 10; 114(15):1633–44. doi:10.1161 /CIRCULATIONAHA.106.613562.

Muller C., et al. Effect of ribose on cardiac adenine nucleotides in a donor model for heart transplantation. *Eur J Med Res.* 1998 Dec 16; 3(12):554–8.

Omran H., et al. D-ribose improves diastolic function and quality of life in congestive heart failure patients: a prospective feasibility study. *Eur J Heart Fail.* 2003 Oct;5(5):615–9. doi:10.1016/S1388-9842(03)00060-6.

Omran H., et al. D-ribose aids congestive heart failure patients. *Exp Clin Cardiol.* 2004 Summer; 9(2):117–8.

Pauly D. F., Johnson C., St. Cyr J. A. The benefits of ribose in cardiovascular disease. *Med Hypotheses.* 2003 Feb; 60(2):149–51.

Pauly D. F., Pepine C. J. D-ribose as a supplement for cardiac energy metabolism. *J Cardiovasc Pharmacol Ther.* 2000 Oct; 5(4):249–58. doi:10.1054/JCPT.2000.18011.

Pauly D. F., Pepine C. J. Ischemic heart disease: metabolic approaches to management. *Clin Cardiol.* 2004; 27(8):439–41. doi:10.1002/clc.4960270802.

Pelliccia A., Di Paolo F. M., Maron B. J. The athlete's heart: remodeling, electrocardiogram and preparticipation screening. *Cardiol Rev.* 2002 Mar–Apr; 10(2):85–90.

Perkowski D., et al. D-ribose improves cardiac indices in patients undergoing “off” pump coronary arterial revascularization. *J Surg Res.* 2007; 137(2):295.

Pliml W., et al. Effects of ribose on exercise-induced ischaemia in stable coronary artery disease. *Lancet.* 1992 Aug 29; 340(8818):507–10. doi:10.1016/0140-6736(92)91709-H.

Pouleur H. Diastolic dysfunction and myocardial energetics. *Eur Heart J.* 1990 May; 11(Suppl C):30–4. doi:10.1093/eurheartj/11.suppl_C.30.

Rich B. S., Havens S. A. The athletic heart syndrome. *Curr Sports Med Rep.* 2004 Mar; 3(2):84–8.

Sami H., Bittar N. The effect of ribose administration on contractile recovery following brief periods of ischemia. *Anesthesiology.* 1987; 67(3A):A74.

Schachter C. L., et al. Effects of short versus long bouts of aerobic exercise in sedentary women with fibromyalgia: a randomized controlled trial. *Phys Ther.* 2003 Apr; 83(4):340–58.

Sinatra S. T. The Sinatra solution: metabolic cardiology. Laguna Beach, CA: Basic Health Publications, Inc; 2011.

Taegtmeyer H. Metabolism — the lost child of cardiology. *J Am Coll Cardiol.* 2000; 36(4):1386–8.

Taegtmeyer H., et al. Energy metabolism in reperfused heart muscle: Metabolic correlates to return of function. *J Am Coll Cardiol.* 1985 Oct; 6(4):864–70. doi:10.1016/S0735-1097 (85)80496-4.

Taegtmeyer H., King L. M., Jones B. E. Energy substrate metabolism, myocardial ischemia, and targets for pharmacotherapy. *Am J Cardiol.* 1998 Sep 3; 82(5A):54K–60K. doi:10.1016 /S0002-9149(98)00538-4.

Teitelbaum J.E., Johnson C., St. Cyr J. The use of D-ribose in chronic fatigue syndrome and fibromyalgia: a pilot study. *J Altern Complement Med.* 2006 Nov;12(9)857–62. doi:10.1089 /acm.2006.12.857.

Tullson P. C., Terjung R. L. Adenine nucleotide synthesis in exercising and endurance-trained skeletal muscle. *Am J Physiol.* 1991 Aug; 261: C. 342–C. 347.

Van Gammeren D., Falk D., Antonio J. The effects of four weeks of ribose supplementation on body composition and exercise performance in healthy, young male recreational bodybuilders: a double-blind, placebo-controlled trial. *Curr Ther Res.* 2002 Aug; 63(8): 486–95. doi:10.1016/S0011-393X(02)80054-6.

Wilson R., MacCarter D, St. Cyr J. D-ribose enhances the identification of hibernating myocardium. *Heart Drug.* 2003; 3:61–2. doi:10.1159/000070908.

Zarzewny R., et al. Influence of ribose on adenine salvage after intense muscle contractions. *J Appl Physiol.* 2001; 91:1775–81.

Zimmer H. G. Restitution of myocardial adenine nucleotides: acceleration by administration of ribose. *J Physiol (Paris).* 1980; 76(7):769–75.

Zimmer H. G. Significance of the 5-phosphoribosyl-1-pyrophosphate pool for cardiac purine and pyrimidine nucleotide synthesis: studies with ribose, adenine, inosine, and orotic acid in rats. *Cardiovasc Drug Ther.* 1998 Apr; 12(Suppl 2):179–87.

Zimmer H. G., et al. Ribose intervention in the cardiac pentose phosphate pathway is not species-specific. *Science*. 1984 Feb 17; 223(4637):712–4. doi:10.1126/science.6420889.

Zimmer H. G., Ibel H. Effects of ribose on cardiac metabolism and function in isoproterenol treated rats. *Am J Physiol*. 1983 Nov; 245: H880–H886.

Пирролохинолинхинон

Aizenman E., et al. Interaction of the putative essential nutrient pyrroloquinoline quinone with the N-methyl-aspartate receptor redox modulatory site. *J Neurosci*. 1992 Jun; 12(6):2362–9.

Aizenman E., et al. Further evidence that pyrroloquinoline quinone interacts with the N-methyl-aspartate receptor redox site in rat cortical neurons in vitro. *Neurosci Lett*. 1994 Feb 28; 168(1–2):189–92. doi:10.1016/0304-3940(94)90447-2.

Bauerly K. A., et al. Pyrroloquinoline quinone nutritional status alters lysine metabolism and modulates mitochondrial DNA content in the mouse and rat. *Biochim Biophys Acta*. 2006 Nov; 1760(11):1741–8. doi:10.1016/j.bbagen.2006.07.009.

Chowanadisai W., et al. Pyrroloquinoline quinone (PQQ) stimulates mitochondrial biogenesis. *FASEB J*. 2007 Apr; 21:854. doi:10.1074/jbc.M109.030130.

Chowanadisai W., et al. Pyrroloquinoline quinone stimulates mitochondrial biogenesis through cAMP response element-binding protein phosphorylation and increased PGC-1 α expression. *J Biol Chem*. 2010 Jan 1; 285(1):142–52. doi:10.1074/jbc.M109.030130.

Debray F. G., Lambert M., Mitchell G. A. Disorders of mitochondrial function. *Curr Opin Pediatr*. 2008 Aug; 20(4):471–82. doi:10.1097/MOP.0b013e328306ebb6.

Felton L. M., Anthony C. Biochemistry: role of PQQ as a mammalian enzyme cofactor? *Nature*. 2005 Feb 3; 433(7025):E10; discussion E11–E12. doi:10.1038/nature03322.

Harris C. B., et al. Dietary pyrroloquinoline quinone (PQQ) alters indicators of inflammation and mitochondrial-related metabolism in human

subjects. *J Nutr Biochem*. 2013 Dec; 24(12):2076–84. doi:10.1016/j.jnutbio.2013.07.008.

Hirakawa A., et al. Pyrroloquinoline quinone attenuates iNOS gene expression in the injured spinal cord. *Biochem Biophys Res Commun*. 2009 Jan 9; 378(2):308–12. doi:10.1016/j.bbrc.2008.11.045.

Jensen F. E., et al. The putative essential nutrient pyrroloquinoline quinone is neuroprotective in a rodent model of hypoxic/ischemic brain injury. *Neuroscience*. 1994 Sep;62(2):399–406. doi:10.1016/0306-4522(94)90375-1.

Kasahara T., Kato T. Nutritional biochemistry: a new redox-cofactor vitamin for mammals. *Nature*. 2003 Apr 24; 422:832. doi:10.1038/422832a.

Kumazawa T., Seno H., Suzuki O. Failure to verify high levels of pyrroloquinoline quinone in eggs and skim milk. *Biochem Biophys Res Commun*. 1993 May 28; 193(1):1–5. doi:10.1006/bbrc.1993.1581.

Kumazawa T., et al. Levels of pyrroloquinoline quinone in various foods. *Biochem J*. 1995;307: 331–3. doi:10.1042/bj3070331.

Kumazawa T., et al. Activation of ras signaling pathways by pyrroloquinoline quinone in NIH3T3 mouse fibroblasts. *Int J Mol Med*. 2007 May; 19(5):765–70. doi:10.3892/ijmm.19.5.765.

Li H. H., et al. Pyrroloquinoline quinone enhances regeneration of transected sciatic nerve in rats. *Chin J Traumatol*. 2005 Aug; 8(4):225–9.

Magnusson O. T., et al. Quinone biogenesis: structure and mechanism of PqqC, the final catalyst in the production of pyrroloquinoline quinone. *Proc Natl Acad Sci U S A*. 2004 May 25;101(21):7913–8. doi:10.1073/pnas.0402640101.

Magnusson O. T., et al. Pyrroloquinoline quinone biogenesis: characterization of PqqC and its H84N and H84A active site variants. *Biochemistry*. 2007; 46(24):7174–86. doi:10.1021/bi700162n.

Matsushita K., et al. *Escherichia coli* is unable to produce pyrroloquinoline quinone (PQQ). *Microbiology*. 1997; 143:3149–56. doi:10.1099/00221287-143-10-3149.

Mitchell A. E., et al. Characterization of pyrroloquinoline quinone amino acid derivatives by electrospray ionization mass spectrometry and

detection in human milk. *Anal Biochem.* 1999 May 1; 269(2):317–25. doi:10.1006/abio.1999.4039.

Muoio D. M., Koves T. R. Skeletal muscle adaptation to fatty acid depends on coordinated actions of the PPARs and PGC-1alpha: implications for metabolic disease. *Appl Physiol Nutr Metab.* 2007 Oct; 32(5):874–83. doi:10.1139/H07-083.

Murase K., et al. Stimulation of nerve growth factor synthesis/secretion in mouse astroglial cells by coenzymes. *Biochem Mol Biol Int.* 1993 Jul; 30(4):615–21.

Nunome K., et al. Pyrroloquinoline quinone prevents oxidative stress-induced neuronal death probably through changes in oxidative status of DJ-1. *Biol Pharm Bull.* 2008 Jul; 31(7): 1321–6. doi:10.1248/bpb.31.1321.

Ohwada K., et al. Pyrroloquinoline quinone (PQQ) prevents cognitive deficit caused by oxidative stress in rats. *J Clin Biochem Nutr.* 2008 Jan; 42(1):29–34. doi:10.3164/jcbn .2008005.

Ouchi A., et al. Kinetic study of the antioxidant activity of pyrroloquinoline-quinol (PQQH(2), a reduced form of pyrroloquinolinequinone) in micellar solution. *J Agric Food Chem.* 2009; 57(2):450–6. doi:10.1021/jf802197d.

Puehringer S., Metlitzky M., Schwarzenbacher R. The pyrroloquinoline quinone biosynthesis pathway revisited: a structural approach. *BMC Biochem.* 2008 Mar 27; 9:8. doi:10.1186/1471-2091-9-8.

Puigserver P. Tissue-specific regulation of metabolic pathways through the transcriptional coactivator PGC1-alpha. *Int J Obes (Lond).* 2005 Mar; 29:S5–S9. doi:10.1038/sj.ijo.0802905.

Rucker R., Chowanadisai W., Nakano M. Potential physiological importance of pyrroloquinoline quinone. *Altern Med Rev.* 2009 Sep; 14(3):268–77.

Rucker R., et al. Biochemistry: is pyrroloquinoline quinone a vitamin? *Nature.* 2005 Feb 3;433(7025): E10–E11; discussion E11–E12. doi:10.1038/nature03323.

Sanchez R. M., et al. Novel role for the NMDA receptor redox modulatory site in the pathophysiology of seizures. *J Neurosci.* 2000 Mar 15; 20(6):2409–17.

Sato K., Toriyama M. Effect of pyrroloquinoline quinone (PQQ) on melanogenic protein expression in murine B16 melanoma. *J Dermatol Sci.* 2009 Feb;53(2):140–5. doi:10.1016/j.jdermsci.2008.08.017.

Scanlon J. M., Aizenman E., Reynolds I. J. Effects of pyrroloquinoline quinone on glutamate-induced production of reactive oxygen species in neurons. *Eur J Pharmacol.* 1997 May 12; 326(1):67–74. doi:10.1016/S0014-2999(97)00137-4.

Steinberg F. M., Gershwin M. E., Rucker R. B. Dietary pyrroloquinoline quinone: growth and immune response in BALB/c mice. *J Nutr.* 1994 May; 124(5):744–53.

Steinberg F., et al. Pyrroloquinoline quinone improves growth and reproductive performance in mice fed chemically defined diets. *Exp Biol Med (Maywood).* 2003 Feb; 228(2):160–6. doi:10.1177/153537020322800205.

Stites T. E., Mitchell A. E., Rucker R. B. Physiological importance of quinoenzymes and the O-quinone family of cofactors. *J Nutr.* 2000 Apr; 130(4):719–27.

Stites T., et al. Pyrroloquinoline quinone modulates mitochondrial quantity and function in mice. *J Nutr.* 2006 Feb; 136(2):390–6.

Tao R., et al. Pyrroloquinoline quinone preserves mitochondrial function and prevents oxidative injury in adult rat cardiac myocytes. *Biochem Biophys Res Commun.* 2007 Nov 16; 363(2):257–62. doi:10.1016/j.bbrc.2007.08.041.

Yamaguchi K., et al. Stimulation of nerve growth factor production by pyrroloquinoline quinone and its derivatives in vitro and in vivo. *Biosci Biotechnol Biochem.* 1993 Jul;57(7):1231–3. doi:10.1271/bbb.57.1231.

Zhang P., et al. Protection of pyrroloquinoline quinone against methylmercury-induced neurotoxicity via reducing oxidative stress. *Free Radic Res.* 2009 Mar; 43(3):224–33. doi:10.1080/10715760802677348.

Zhang Y., Feustel P. J., Kimelberg H. K. Neuroprotection by pyrroloquinoline quinone (PQQ) in reversible middle cerebral artery occlusion in the adult rat. *Brain Res.* 2006 Jun 13; 1094(1): 200–6. doi:10.1016/j.brainres.2006.03.111.

Zhang Y., Rosenberg P. A. The essential nutrient pyrroloquinoline quinone may act as a neuroprotectant by suppressing peroxynitrite for-

mation. *Eur J Neurosci.* 2002 Sep; 16(6): 1015–24. doi:10.1046/j.1460-9568.2002.02169.x.

Zhu B.Q., et al. Pyrroloquinoline quinone (PQQ) decreases myocardial infarct size and improves cardiac function in rat models of ischemia and ischemia/reperfusion. *Cardiovasc Drugs Ther.* 2004 Nov; 18(6):421–31. doi:10.1007/s10557-004-6219-x.

Zhu B. Q., et al. Comparison of pyrroloquinoline quinone and/or metoprolol on myocardial infarct size and mitochondrial damage in a rat model of ischemia/reperfusion injury. *J Cardiovasc Pharmacol Ther.* 2006 Jun; 11(2):119–28. doi:10.1177/1074248406288757.

Темный шоколад

Al-Safi S. A., et al. Dark chocolate and blood pressure: a novel study from Jordan. *Curr Drug Deliv.* 2011 Nov; 8(6):595–9. doi:10.2174/156720111797635496.

Buitrago-Lopez A., et al. Chocolate consumption and cardiometabolic disorders: systematic review and meta-analysis. *BMJ.* 2011 Aug 26; 343:d4488. doi:10.1136/bmj.d4488.

Ellinger S., et al. Epicatechin ingested via cocoa products reduces blood pressure in humans: a nonlinear regression model with a Bayesian approach. *Am J Clin Nutr.* 2012 Jun;95(6): 1365–77. Epub 2012 May 2. doi:10.3945/ajcn.111.029330.

Golomb B. A., Koperski S., White H. L. Association between more frequent chocolate consumption and lower body mass index. *Arch Intern Med.* 2012 Mar 26; 172(6):519–21. doi:10.1001/archinternmed.2011.2100.

Messerli F. H. Chocolate consumption, cognitive function, and Nobel laureates. *N Engl J Med.* 2012 Oct 18; 367(16):1562–4. Epub 2012 Oct 10. doi:10.1056/NEJMon1211064.

Nehlig A. The neuroprotective effects of cocoa flavanol and its influence on cognitive performance. *Br J Clin Pharmacol.* 2013 Mar; 75(3):716–27. doi:10.1111/j.1365-2125.2012.04378.x.

Nogueira L., et al. (-)-Epicatechin enhances fatigue resistance and oxidative capacity in mouse muscle. *J Physiol.* 2011 Sep 15; 589(Pt 18):4615–31. Epub 2011 Jul 25. doi:10.1113/jphysiol.2011.209924.

Persson I. A., et al. Effects of cocoa extract and dark chocolate on angiotensin-converting enzyme and nitric oxide in human endothelial cells and healthy volunteers—a nutrigenomics perspective. *J Cardiovasc Pharmacol.* 2011 Jan; 57(1):44–50. doi:10.1097/FJC.0b013e3181fe62e3.

Sathyapalan T., et al. High cocoa polyphenol rich chocolate may reduce the burden of the symptoms in chronic fatigue syndrome. *Nutr J.* 2010 Nov 22; 9:55. doi:10.1186/1475-2891-9-55.

Кофермент Q10

Cooper J. M., et al. Coenzyme Q10 and vitamin E deficiency in Friedreich's ataxia: predictor of efficacy of vitamin E and coenzyme Q10 therapy. *Eur J Neurol.* 2008 Dec; 15(12):1371–9. doi:10.1111/j.1468-1331.2008.02318.x.

Crane F. L., Low H., Sun I. L. Evidence for a relation between plasma membrane coenzyme Q and autism. *Front Biosci (Elite Ed).* 2013 Jun 1; 5:1011–6.

Del Pozo-Cruz J., et al. Relationship between functional capacity and body mass index with plasma coenzyme Q10 and oxidative damage in community-dwelling elderly-people. *Exp Gerontol.* 2014 Apr; 52:46–54. Epub 2014 Feb 7.

Duberley K. E., et al. Effect of coenzyme Q10 supplementation on mitochondrial electron transport chain activity and mitochondrial oxidative stress in coenzyme Q10 deficient human neuronal cells. *Int J Biochem Cell Biol.* 2014 May; 50:60–3. Epub 2014 Feb 15. doi:10.1016/j.biocel.2014.02.003.

Liang J. M., et al. Role of mitochondrial function in the protective effects of ischaemic postconditioning on ischaemia/reperfusion cerebral damage. *J Int Med Res.* 2013 Jun 1; 41(3):618–27. Epub 2013 Apr 4. doi:10.1177/0300060513476587.

Langsjoen P. H., Langsjoen A. M. Supplemental ubiquinol in patients with advanced congestive heart failure. *Biofactors*. 2008; 32(1–4):119–28. doi:10.1002/biof.5520320114.

Lass A., Sohal R. S. Comparisons of coenzyme Q bound to mitochondrial membrane proteins among different mammalian species. *Free Radic Biol Med*. 1999 Jul; 27(1–2):220–6. doi:10.1016/S0891-5849(99)00085-4.

Mancuso M., et al. Coenzyme Q10 in neuromuscular and neurodegenerative disorders. *Curr Drug Targets*. 2010 Jan; 11(1):111–21. doi:10.2174/138945010790031018.

Matthews R. T., et al. Coenzyme Q10 administration increases brain mitochondrial concentrations and exerts neuroprotective effects. *Proc Natl Acad Sci U S A*. 1998 Jul 21; 95(15):8892–7.

Mortensen S. A., et al. Coenzyme Q10: clinical benefits with biochemical correlates suggesting a scientific breakthrough in the management of chronic heart failure. *Int J Tissue React*. 1990; 12(3):155–62.

Muroyama A. An alternative medical approach for the neuroprotective therapy to slow the progression of Parkinson's disease. *Yakugaku Zasshi*. 2013; 133(8):849–56. doi:10.1248 /yakushi.13-00158.

Morris G., et al. Coenzyme Q10 depletion in medical and neuropsychiatric disorders: potential repercussions and therapeutic implications. *Mol Neurobiol*. 2013 Dec; 48(3):883–903. Epub 2013 Jun 13. doi:10.1007/s12035-013-8477-8.

Nicolson G. L. Mitochondrial dysfunction and chronic disease: treatment with natural supplements. *Altern Ther Health Med*. 2013 Aug 15. pii: at5027. Epub ahead of print.

Ochoa J. J., et al. Coenzyme Q10 protects from aging-related oxidative stress and improves mitochondrial function in heart of rats fed a polyunsaturated fatty acid (PUFA)-rich diet. *J Gerontol A Biol Sci Med Sci*. 2005 Aug; 60(8):970–5. doi:10.1093/gerona/60.8.970.

Rodriguez M. C., et al. Beneficial effects of creatine, CoQ10, and lipoic acid in mitochondrial disorders. *Muscle Nerve*. 2007 Feb; 35(2):235–42. doi:10.1002/mus.20688.

Rosenfeldt F. L., et al. Coenzyme Q10 improves the tolerance of the senescent myocardium to aerobic and ischemic stress: studies in rats

and in human atrial tissue. *Biofactors*. 1999; 9(2–4):291–9. doi:10.1002/biof.5520090226.

Rosenfeldt F. L., et al. Coenzyme Q10 protects the aging heart against stress: studies in rats, human tissues, and patients. *Ann N Y Acad Sci*. 2002 Apr; 959:355–9; discussion 463–5. doi:10.1111/j.1749-6632.2002.tb02106.x.

Rosenfeldt F. L., et al. The effects of ageing on the response to cardiac surgery: protective strategies for the ageing myocardium. *Biogerontology*. 2002;3(1–2):37–40.

Salama M., et al. Co-enzyme Q10 to treat neurological disorders: basic mechanisms, clinical outcomes, and future research direction. *CNS Neurol Disord Drug Targets*. 2013 Aug; 12(5):641–4. Epub 2013 Apr 4. doi:10.2174/18715273113129990071.

Shults C. W., et al. Effects of coenzyme Q10 in early Parkinson disease: evidence of slowing of the functional decline. *Arch Neurol*. 2002 Oct; 59(10):1541–50. doi:10.1001/archneur.59.10.1541.

Sinatra S. T. The Sinatra solution: metabolic cardiology. Laguna Beach, CA: Basic Health Publications, Inc; 2011.

Sohal R. S., Forster M. J. Coenzyme Q, oxidative stress and aging. *Mitochondrion*. 2007 Jun; 7 Suppl:S103–11. doi:10.1016/j.mito.2007.03.006.

Spindler M., Beal M. F., Henchcliffe C. Coenzyme Q10 effects in neurodegenerative disease. *Neuropsychiatr Dis Treat*. 2009; 5:597–610. Epub 2009 Nov 16. doi:10.2147/NDT.S5212.

Совместное применение статинов и кофермента Q10

Brown M. S., inventor. Merck & Co., Inc., assignee. Coenzyme Q10 with HMG-CoA reductase inhibitors. United States patent US 4933165. 1989 Jan 18.

Caso G., et al. Effect of coenzyme Q10 on myopathic symptoms in patients treated with statins. *Am J Cardiol*. 2007 May 15; 99(10):1409–12. doi:10.1016/j.amjcard.2006.12.063.

Marcoff L., Thompson P. D. The role of coenzyme Q10 in statin-associated myopathy: a systematic review. *J Am Coll Cardiol*. 2007 Jun 12; 49(23):2231–7. doi:10.1016/j.jacc.2007.02.049.

Parker B. A., et al. Effect of statins on creatine kinase levels before and after a marathon run. *Am J Cardiol.* 2012 Jan 15; 109(2):282–7. doi:10.1016/j.amjcard.2011.08.045.

Tobert J. A., inventor. Merck & Co Inc., assignee. Coenzyme Q10 with HMG-CoA reductase inhibitors. United States patent US 4929437. 1990 May 29.

L-карнитин

Akisu M., et al. Protective effect of dietary supplementation with L-arginine and L-carnitine on hypoxia/reoxygenation-induced necrotizing enterocolitis in young mice. *Bio Neonate.* 2002;81(4):260–5. doi:10.1159/000056757.

Bahl J. J., Bressler R. The pharmacology of carnitine. *Annu Rev Pharmacol Toxicol.* 1987;27: 257–77. doi:10.1146/annurev.pa.27.040187.001353.

Binienda Z. K. Neuroprotective effects of L-carnitine in induced mitochondrial dysfunction. *Ann N Y Acad Sci.* 2003 May; 993:289–95; discussion 345–9. doi:10.1111/j.1749-6632.2003.tb07536.

Brass E. P., Hoppel C. L. Relationship between acid-soluble carnitine and coenzyme A pools in vivo. *Biochem J.* 1980 Sep 15; 190(3):495–504. doi:10.1042/bj1900495.

Bremer J. Carnitine: metabolism and functions. *Physiol Rev.* 1983 Oct; 63(4):1420–80.

Ferrari R., et al. Therapeutic effects of L-carnitine and propionyl-L-carnitine on cardiovascular diseases: a review. *Ann N Y Acad Sci.* 2004 Nov; 1033:79–91. doi:10.1196/annals.1320.007.

Geier D. A., Geier M. R. L-carnitine exposure and mitochondrial function in human neuronal cells. *Neurochem Res.* 2013 Nov; 38(11):2336–41. Epub 2013 Sep 5. doi:10.1007/s11064-013-1144-7.

Hagen T. M., et al. Acetyl-L-carnitine fed to old rats partially restores mitochondrial function and ambulatory activity. *Proc Natl Acad Sci USA.* 1998 Aug 4; 95(16):9562–6.

Hagen T. M., et al. Feeding acetyl-L-carnitine and lipoic acid to old rats significantly improves metabolic function while decreasing oxidative

stress. Proc Natl Acad Sci U S A. 2002 Feb 19; 99(4):1870–5. doi:10.1073/pnas.261708898.

Hoppel C. The role of carnitine in normal and altered fatty acid metabolism. Am J Kidney Dis. 2003 Apr; 41(4 Suppl 4):S4–12. doi:10.1016/S0272-6386(03)00112-4.

Horne D. W., Broquist H. P. Role of lysine and e-N-trimethyllysine in carnitine biosynthesis. I: studies in *Neurospora crassa*. J Biol Chem. 1973; 248(6):2170–5.

Hulse J. D., Ellis S. R., Henderson L. M. Carnitine biosynthesis: beta-hydroxylation of trimethyllysine by an alpha-ketoglutarate-dependent mitochondrial dioxxygenase. J Biol Chem. 1978 Mar 10; 253(5):1654–9.

Jacobs P. L., Goldstein E. R. Long-term glycine propionyl-L-carnitine supplementation and paradoxical effects on repeated anaerobic sprint performance. J Int Soc Sports Nutr. 2010 Oct 28; 7:35. doi:10.1186/1550-2783-7-35.

Kabaroglu C., et al. Effects of L-arginine and L-carnitine on hypoxia/reoxygenation-induced intestinal injury. Pediatr Int. 2005 Feb; 47(1):10–4. doi:10.1111/j.1442-200x.2005.01999.x.

Kuratsune H., et al. Acylcarnitine deficiency in chronic fatigue syndrome. Clin Infect Dis. 1994 Jan; 18 Suppl 1:S. 62–7.

Lango R., et al. Propionyl-L-carnitine improves hemodynamics and metabolic markers of cardiac perfusion during coronary surgery in diabetic patients. Cardiovasc Drugs Ther. 2005 Aug; 19(4):267–75.

Liu J., et al. Memory loss in old rats is associated with brain mitochondrial decay and RNA/ DNA oxidation: partial reversal by feeding acetyl-L-carnitine and/or R- α -lipoic acid. Proc Natl Acad Sci U S A. 2002 Feb 19; 99(4):2356–61. doi:10.1073/pnas.261709299.

Lombard K. A., et al. Carnitine status of lactoovovegetarians and strict vegetarian adults and children. Am J Clin Nutr. 1989; 50(2):301–6.

McGarry J. D., Brown N. F. The mitochondrial carnitine palmitoyltransferase system. From concept to molecular analysis. Eur J Biochem. 1997 Feb 15; 244(1):1–14. doi:10.1111/j.1432-1033.1997.00001.

Montgomery S. A., Thal L. J., Amrein R. Meta-analysis of double blind randomized controlled clinical trials of acetyl-L-carnitine versus placebo in the treatment of mild cognitive impairment and mild Alzheimer's disease. *Int Clin Psychopharmacol.* 2003 Mar; 18(2):61–71. doi:10.1097/01.yic.0000058280.28578.79.

Mortensen S. A., et al. The effect of coenzyme Q10 on morbidity and mortality in chronic heart failure: results from the Q-SYMBIO: a randomized double-blind trial. *JACC Heart Fail.* 2014 Dec; 2(6):641–9. doi:10.1016/j.jchf.2014.06.008.

Noland R. C., et al. Carnitine insufficiency caused by aging overnutrition compromises mitochondrial performance and metabolic control. *J Biol Chem.* 2009 Aug 21; 284(34): 22840–52. doi:10.1074/jbc.M109.032888.

Osmundsen H., Bremer J., Pedersen J. I. Metabolic aspects of peroxisomal betaoxidation. *Biochim Biophys Acta.* 1991 Sep 11; 1085(2):141–58. doi:10.1016/0005-2760(91)90089-Z.

Pande S. V. A mitochondrial carnitine acylcarnitine translocase system. *Proc Natl Acad Sci U S A.* 1975 Mar; 72(3):883–7.

Pande S. V., Parvin R. Carnitine-acylcarnitine translocase catalyzes an equilibrating unidirectional transport as well. *J Biol Chem.* 1980 Apr 10; 255(7):2994–3001.

Plioplys A. V., Plioplys S. Serum levels of carnitine in chronic fatigue syndrome: clinical correlates. *Neuropsychobiology* 1995; 32:132–8.

Pons R., De Vivo D. C. Primary and secondary carnitine deficiency syndromes. *J Child Neurol.* 1995 Nov 1; 10 Suppl 2:S8–24.

Ramsay R. R., Arduini A. The carnitine acyltransferases and their role in modulating acyl-CoA pools. *Arch Biochem Biophys.* 1993 May; 302(2):307–14. doi:10.1006/abbi.1993.1216.

Rebouche C. J. Kinetics, pharmacokinetics, and regulation of L-carnitine and acetyl-L-carnitine metabolism. *Ann N Y Acad Sci.* 2004 Nov;1033:30–41.

Rebouche C. J., Paulson D. J. Carnitine metabolism and function in humans. *Annu Rev Nutr.* 1986; 6:41–66.

Rebouche C. J., Paulson D. J. Carnitine function and requirements during the life cycle. *FASEB J.* 1992; 6 (15):3379–86. doi:10.1146/annurev.nu.06.070186.000353.

Reuter S. E., Evans A. M. Carnitine and acylcarnitines: pharmacokinetic, pharmacological and clinical aspects. *Clin Pharmacokinet.* 2012 Sep 1; 51(9):553–72. doi:10.2165/11633940-000000000-00000.

Sachan D. S., Broquist H. P. Synthesis of carnitine from epsilon-N-trimethyllysine in post mitochondrial fractions of *Neurospora crassa*. *Biochem Biophys Res Commun.* 1980 Sep 30; 96(2):870–5. doi:10.1016/0006-291X(80)91436-9.

Sachan D. S., Hoppel C. L. Carnitine biosynthesis. Hydroxylation of N-6-trimethyl-lysine to 3-hydroxy-N6-trimethyl-lysine. *Biochem J.* 1980 May 15; 188 (2):529–34. doi:10.1042/bj1880529.

Serati A. R., et al. L-carnitine treatment in patients with mild diastolic heart failure is associated with improvement in diastolic function and symptoms. *Cardiology.* 2010; 116(3):178–82. doi:10.1159/000318810.

Sinatra S. T. The Sinatra solution: metabolic cardiology. Laguna Beach, CA: Basic Health Publications, Inc; 2011.

Steiber A., Kerner J., Hoppel C. L. Carnitine: a nutritional, biosynthetic, and functional perspective. *Mol Aspects Med.* 2004 Oct–Dec; 25(5–6):455–73. doi:10.1016/j.mam.2004.06.006.

Tanphaichitr V., Broquist H. P. Role of lysine and ε-N-trimethyllysine in carnitine biosynthesis. II: studies in the rat. *J Biol Chem.* 1973; 248(6):2176–81.

Vaz F. M., Wanders R. J. Carnitine biosynthesis in mammals. *Biochem J.* 2002 Feb 1; 361(Part 3): 417–29. doi:10.1042/bj3610417.

Virmani A., et al. The protective role of L-carnitine against neurotoxicity evoked by drug of abuse, methamphetamine, could be related to mitochondrial dysfunction. *Ann N Y Acad Sci.* 2002 Jun;965:225–32. doi:10.1111/j.1749–6632.2002.tb04164.

Магний

Abbott R. D., et al. Dietary magnesium intake and the future risk of coronary heart disease (the Honolulu Heart Program). *Am J Cardiol.* 2003 Sep 15; 92(6):665–9. doi:10.1016/S0002-9149(03)00819-1.

Alloui A., et al. Does Mg²⁺ deficiency induce a long-term sensitization of the central nociceptive pathways? *Eur J Pharmacol.* 2003 May 23; 469(1–3):65–9. doi:10.1016/S0014-2999(03)01719-9.

Amighi J., et al. Low serum magnesium predicts neurological patients with advanced atherosclerosis. *Stroke.* 2004 Jan; 35(1):22–7. doi:10.1161/01.STR.0000105928.95124.1F.

Demougeot C., et al. Effect of diets with different magnesium content in ischemic stroke rats. *Neurosci Lett.* 2004 May 13; 362(1):17–20. doi:10.1016/j.neulet.2004.01.034.

Eray O., et al. Magnesium efficacy in magnesium deficient and nondeficient patients with rapid ventricular response atrial fibrillation. *Eur J Emerg Med.* 2000 Dec; 7(4):287–90.

Fox C., Ramsoomair D., Carter C. Magnesium: its proven and potential clinical significance. *South Med J.* 2001 Dec; 94(12):1195–201.

Hagen T. M., et al. (R)-alpha-lipoic acid-supplemented old rats have improved mitochondrial function, decreased oxidative damage, and increased metabolic rate. *FASEB J.* 1999 Feb; 13(2):411–8.

Hagen T. M., et al. Mitochondrial decay in the aging rat heart: evidence for improvement by dietary supplementation with acetyl-L-carnitine and/or lipoic acid. *Ann NY Acad Sci.* 2002 Apr; 959:491–507. doi:10.1111/j.1749-6632.2002.tb02119.

Hans C. P., Chaudhary D. P., Bansal D. D. Magnesium deficiency increases oxidative stress in rats. *Ind J Exp Biol.* 2002 Nov; 40(11):1275–9.

Hans C. P., Chaudhary D. P., Bansal D. D. Effect of magnesium supplementation on oxidative stress in alloxanic diabetic rats. *Magnes Res.* 2003 Mar; 16(1):13–9.

Klevay L. M., Milne D. B. Low dietary magnesium increases supraventricular ectopy. *Am J Clin Nutr.* 2002 Mar; 75(3):550–4.

Kramer J. H., et al. Dietary magnesium intake influences circulating pro-inflammatory neuropeptide levels and loss of myocardial tolerance to postischemic stress. *Exp Biol Med* (Maywood). 2003 Jun; 228(6):665–73.

Kubota T., et al. Mitochondria are intracellular magnesium stores: investigation by simultaneous fluorescent imagings in PC12 cells. *Biochim Biophys Acta*. 2005 May 15; 1744(1):19–28. Epub 2004 Nov 11. doi:10.1016/j.bbamcr.2004.10.013.

Laires M. J., Monteiro C. P., Bicho M. Role of cellular magnesium in health and human disease. *Front Biosci*. 2004 Jan; 9:262–76.

Lukaski H. C., Nielsen F. H. Dietary magnesium depletion affects metabolic responses during submaximal exercise in postmenopausal women. *J Nutr*. 2002 May; 132(5):930–5.

Maier J. A., et al. Low magnesium promotes endothelial cell dysfunction: implications for atherosclerosis, inflammation and thrombosis. *Biochim Biophys Acta*. 2004 May 24; 1689(1):13–21. doi:10.1016/j.bbadis.2004.01.002.

Moreira P. I., et al. Lipoic acid and N-acetyl cysteine decrease mitochondrial-related oxidative stress in Alzheimer disease patient fibroblasts. *J Alzheimers Dis*. 2007 Sep; 12(2):195–206.

Nair R. R., Nair P. Alteration of myocardial mechanics in marginal magnesium deficiency. *Magnes Res*. 2002 Dec; 15(3–4):287–306.

Nakayama S., et al. Mechanisms for monovalent cation-dependent depletion of intracellular Mg^{2+} : Na^{+} -independent Mg^{2+} pathways in guinea-pig smooth muscle. *J Physiol*. 2003 Sep 15; 551(Pt 3):843–53. doi:10.1113/jphysiol.2003.047795.

Paolisso G., Barbagallo M. Hypertension, diabetes mellitus, and insulin resistance: the role of intracellular magnesium. *Am J Hyperten*. 1997 Mar 1; 10(3):346–55. doi:10.1016/S0895-7061(96)00342-1.

Resnick L. M., et al. Cellular-free magnesium depletion in brain and muscle of normal and preeclamptic pregnancy: a nuclear magnetic resonance spectroscopic study. *Hypertension*. 2004 Sep; 44(3):322–6. doi:10.1161/01.HYP.0000137592.76535.8c.

Rubenowitz E., Axelsson G., Rylander R. Magnesium in drinking water and death from myocardial infarction. *Am J Epidemiol*. 1996; 143:456–62.

Sinatra S. T. The Sinatra solution: metabolic cardiology. Laguna Beach, CA: Basic Health Publications, Inc; 2011.

Takaya J., Higashino H., Kobayashi Y. Intracellular magnesium and insulin resistance. *Magnes Res.* 2004 Jun; 17(2):126–36.

Touyz R. M. Role of magnesium in the pathogenesis of hypertension. *Mol Aspects Med.* 2003 Feb–Jun; 24(1–3):107–36. doi:10.1016/S0098-2997(02)00094-8.

Touyz R. M., et al. Effects of low dietary magnesium intake on development of hypertension in stroke-prone spontaneously hypertensive rats: role of reactive oxygen species. *J Hypertens.* 2002 Nov; 20(11):2221–32.

Альфа-липоевая кислота

Biewenga G. P., Haenen G. R., Bast A. The pharmacology of the antioxidant lipoic acid. *Gen Pharmacol.* 1997 Sep; 29(3):315–31. doi:10.1016/S0306-3623(96)00474-0.

Femiano E., Scully C. Burning mouth syndrome (BMS): double blind controlled study of alphalipoic acid (thioctic acid) therapy. *J Oral Pathol Med.* 2002 May; 31(5):267–9. doi:10.1034/j.1600-0714.2002.310503.

Hagen T. M., et al. (R)-alpha-lipoic acid-supplemented old rats have improved mitochondrial function, decreased oxidative damage, and increased metabolic rate. *FASEB J.* 1999 Feb; 13(2):411–8.

Hagen T. M., et al. Feeding acetyl-L-carnitine and lipoic acid to old rats significantly improves metabolic function while decreasing oxidative stress. *Proc Natl Acad Sci USA.* 2002 Feb 19; 99(4):1870–5. doi:10.1073/pnas.261708898.

Hagen T. M., et al. Mitochondrial decay in the aging rat heart: evidence for improvement by dietary supplementation with acetyl-L-carnitine and/or lipoic acid. *Ann NY Acad Sci.* 2002 Apr; 959:491–507. doi:10.1111/j.1749-6632.2002.tb02119.

Hager K., et al. Alpha-lipoic acid as a new treatment option for Alzheimer type dementia. *Arch Gerontol Geriatr.* 2001 Jun; 32(3):275–82.

Jia L., et al. Acrolein, a toxicant in cigarette smoke, causes oxidative damage and mitochondrial dysfunction in RPE cells: protection by (R)-

alpha-lipoic acid. *Invest Ophthalmol Vis Sci.* 2007 Jan; 48(1):339–48. doi:10.1167/iovs.06-0248.

Jiang T., et al. Lipoic acid restores age-associated impairment of brain energy metabolism through the modulation of Akt/JNK signaling and PGC1 α transcriptional pathway. *Aging Cell.* 2013 Dec; 12(6):1021–31. doi:10.1111/accel.12127. doi:10.1111/accel.12127.

Kim D. C., et al. Lipoic acid prevents the changes of intracellular lipid partitioning by free fatty acid. *Gut Liver.* 2013 Mar; 7(2):221–7. doi:10.5009/gnl.2013.7.2.221.

Li C. J., et al. Attenuation of myocardial apoptosis by alpha-lipoic acid through suppression of mitochondrial oxidative stress to reduce diabetic cardiomyopathy. *Chin Med J (Engl).* 2009 Nov 5; 122(21):2580–6.

Liu J., Killilea D. W., Ames B. N. Age-associated mitochondrial oxidative decay: improvement of carnitine acetyltransferase substrate-binding affinity and activity in brain by feeding old rats acetyl-L-carnitine and/or R-alpha-lipoic acid. *Proc Natl Acad Sci U S A.* 2002 Feb 19; 99(4):1876–81. doi:10.1073/pnas.261709098.

Liu J., et al. Delaying brain mitochondrial decay and aging with mitochondrial antioxidants and metabolites. *Ann NY Acad Sci.* 2002 Apr; 959:133–66. doi:10.1111/j.1749-6632.2002.tb02090.x.

Liu J., et al. Memory loss in old rats is associated with brain mitochondrial decay and RNA/ DNA oxidation: partial reversal by feeding acetyl-L-carnitine and/or R-alpha- lipoic acid. *Proc Natl Acad Sci U S A.* 2002 Feb 19; 99(4):2356–61. doi:10.1073/pnas.261709299.

Meydani M., et al. The effect of long-term dietary supplementation with antioxidants. *Ann N Y Acad Sci.* 1998 Nov 20; 854:352–60. doi:10.1111/j.1749-6632.1998.tb09915.

Nyengaard J. R., et al. Interactions between hyperglycemia and hypoxia: implications for diabetic retinopathy. *Diabetes.* 2004 Nov; 53(11):2931–8. doi:10.2337/diabetes.53.11.2931.

Scott B. C., et al. Lipoic and dihydrolipoic acids as antioxidants. A critical evaluation. *Free Radic Res.* 1994 Feb; 20(2):119–33. doi:10.3109/10715769409147509.

Tappel A., Fletcher B., Deamer D. Effect of antioxidants and nutrients on lipid peroxidation fluorescent products and aging parameters in the mouse. *J Gerontol.* 1973 Oct; 28(4):415–24. doi:10.1093/geronj/28.4.415.

Thornalley P. J. Glycation in diabetic neuropathy: characteristics, consequences, causes, and therapeutic options. *Int Rev Neurobiol.* 2002; 50:37–7. doi:10.1016/S0074-7742(02)50072-6.

Williamson J. R., et al. Hyperglycemic pseudohypoxia and diabetic complications. *Diabetes.* 1993 Jun; 42(6):801–13. doi:10.2337/diab.42.6.801.

Ziegler D., et al. Treatment of symptomatic diabetic polyneuropathy with the antioxidant alpha-lipoic acid: a meta-analysis. *Diabet Med.* 2004 Feb; 21(2):114–21. doi:10.1111/j.1464-5491.2004.01109.

Zhou L., et al. α -Lipoic acid ameliorates mitochondrial impairment and reverses apoptosis in FABP3-overexpressing embryonic cancer cells. *J Bioenerg Biomembr.* 2013 Oct;45(5): 459–66. Epub 2013 Mar 28.

Креатин

Andrews R., et al. The effect of dietary creatine supplementation on skeletal muscle metabolism in congestive heart failure. *Eur Heart J.* 1998 Apr; 19(4):617–22.

Balestrino M., et al. Role of creatine and phosphocreatine in neuronal protection from anoxic and ischemic damage. *Amino Acids.* 2002; 23(1–3):221–9. doi:10.1007/s00726-001-0133-3.

Broqvist M., et al. Nutritional assessment and muscle energy metabolism in severe chronic congestive heart failure—effects of long-term dietary supplementation. *Eur Heart J.* 1994 Dec;15(12):1641–50. doi:10.1093/oxfordjournals.eurheartj.a060447.

Ferrante R. J., et al. Neuroprotective effects of creatine in a transgenic mouse model of Huntington's disease. *J Neurosci.* 2000 Jun 15;20(12):4389–97.

Field M. L. Creatine supplementation in congestive heart failure [letter]. *Cardiovasc Res* 1996 Jan; 31(1):174–6.

Gordon A., et al. Creatine supplementation in chronic heart failure increases skeletal muscle creatine phosphate and muscle performance. *Cardiovasc Res.* 1995 Sep; 30(3):413–8.

Klivenyi P., et al. Neuroprotective effects of creatine in a transgenic animal model of amyotrophic lateral sclerosis. *Nat Med.* 1999 Mar; 5(3):347–50. doi:10.1038/6568.

Malcon C., Kaddurah-Daouk R., Beal M. F. Neuroprotective effects of creatine administration against NMDA and malonate toxicity. *Brain Res.* 2000 Mar 31; 860(1–2):195–8. doi:10.1016/S0006-8993(00)02038-2.

Matthews R. T., et al. Neuroprotective effects of creatine and cyclocreatine in animal models of Huntington's disease. *J Neurosci.* 1998 Jan; 18(1):156–63.

Matthews R. T., et al. Creatine and cyclocreatine attenuate MPTP neurotoxicity. *Exp Neurol.* 1999 May; 157(1):142–9. doi:10.1006/exnr.1999.7049.

Park J. H., et al. Use of P-31 magnetic resonance spectroscopy to detect metabolic abnormalities in muscles of patients with fibromyalgia. *Arthritis Rheum.* 1998 Mar; 41(3):406–13. doi:10.1002/1529-0131(199803)41:3<406::AID-ART5>3.0.CO;2-L.

Tarnopolsky M., Martin J. Creatine monohydrate increases strength in patients with neuromuscular disease. *Neurology.* 1999 Mar 10; 52(4):854–7.

Walter M. C., et al. Creatine monohydrate in muscular dystrophies: a double blind, placebo-controlled clinical study. *Neurology.* 2000 May 9; 54(9):1848–50.

Витамины группы В

Bernsen P. L., et al. Successful treatment of pure myopathy, associated with complex I deficiency, with riboflavin and carnitine. *Arch Neurol.* 1991 Mar; 48(3):334–8. doi:10.1001/archneur.1991.00530150106028.

Bernsen P. L., et al. Treatment of complex I deficiency with riboflavin. *J Neurol Sci.* 1993 Sep; 118(2):181–7. doi:10.1016/0022-510X(93)90108-B.

Bettendorff L., et al. Low thiamine diphosphate levels in brains of patients with frontal lobe degeneration of the non-Alzheimer's type. *J Neurochem.* 1997 Nov; 69(5):2005–10. doi:10.1046/j.1471-4159.1997.69052005.

Bogan K. L., Brenner C. Nicotinic acid, nicotinamide, and nicotinamide riboside: a molecular evaluation of NAD⁺ precursor vitamins in hu-

man nutrition. *Annu Rev Nutr.* 2008; 28: 115–30. doi:10.1146/annurev.nutr.28.061807.155443.

Bottiglieri T. Folate, vitamin B12, and s-adenosylmethionine. *Psychiatr Clin North Am.* 2013 Mar;36(1):1–13. doi:10.1016/j.psc.2012.12.001.

Bugiani M., et al. Effects of riboflavin in children with complex II deficiency. *Brain Dev.* 2006 Oct; 28(9):576–81. doi:10.1016/j.braindev.2006.04.001.

Cantó C., et al. The NAD(+) precursor nicotinamide riboside enhances oxidative metabolism and protects against high-fat diet-induced obesity. *Cell Metab.* 2012 Jun 6;15(6):838–47. doi:10.1016/j.cmet.2012.04.022.

Czerniecki J., Czygier M. Cooperation of divalent ions and thiamin diphosphate in regulation of the function of pig heart pyruvate dehydrogenase complex. *J Nutr Sci Vitaminol (Tokyo).* 2001 Dec; 47(6):385–6.

Denu J. M. Vitamins and aging: pathways to NAD+ synthesis. *Cell.* 2007 May 4;129(3):453–4. doi:10.1016/j.cell.2007.04.023.

Garbin L., Plebani M., Terribile P. M. Effect of ACP (pyridoxine-2-oxoglutarate) on CCl4 intoxication and in streptozotocin-induced ketosis in rat. *Acta Vitaminol Enzymol.* 1977;31(6):175–8.

Gerards M., et al. Riboflavin-responsive oxidative phosphorylation complex I deficiency caused by defective ACAD9: new function for an old gene. *Brain.* 2011 Jan; 134(Pt 1):210–9. doi:10.1093/brain/awq273.

Hartman T. J., et al. Association of the B-vitamins pyridoxal 5'-phosphate (B(6)), B(12), and folate with lung cancer risk in older men. *Am J Epidemiol.* 2001 Apr 1; 153(7):688–94. doi:10.1093/aje/153.7.688.

Iliev I. S., et al. Enzyme activity changes in chronic alcoholic intoxication and the simultaneous administration of pyridoxine. *Vopr Pitan.* 1982 Nov; (6):54–6.

Imai S. I., Guarente L. NAD(+) and sirtuins in aging and disease. *Trends Cell Biol.* 2014 Aug; 24(8):464–71. Epub 2014 Apr 28. doi:10.1016/j.tcb.2014.04.002.

Ke Z. J., et al. Reversal of thiamine deficiency-induced neurodegeneration. *J Neuropathol Exp Neurol.* 2003 Feb;62(2):195–207. doi:10.1093/jnen/62.2.195.

Kelly G. The coenzyme forms of vitamin B12: toward an understanding of their therapeutic potential. *Altern Med Rev.* 1997 Sep; 2(6):459–71.

Kotegawa M., Sugiyama M., Haramaki N. Protective effects of riboflavin and its derivatives against ischemic reperfused damage of rat heart. *Biochem Mol Biol Int.* 1994 Oct; 34(4):685–91.

Maassen J. A. Mitochondrial diabetes, diabetes and the thiamine-responsive megaloblastic anaemia syndrome and MODY-2. Diseases with common pathophysiology? *Panminerva Med.* 2002 Dec; 44(4):295–300.

Magni G., et al. Enzymology of mammalian NAD metabolism in health and disease. *Front Biosci.* 2008 May 1; 13:6135–54.

Marriage B., Clandinin M. T., Glerum D. M. Nutritional cofactor treatment in mitochondrial disorders. *J Am Diet Assoc.* 2003 Aug; 103(8):1029–38. doi:10.1053/jada.2003.50196.

McComsey G. A., Lederman M. M. High doses of riboflavin and thiamine may help in secondary prevention of hyperlactatemia. *AIDS Read.* 2002 May; 12(5):222–4.

Miner S. E., et al. Pyridoxine improves endothelial function in cardiac transplant recipients. *J Heart Lung Transplant.* 2001 Sep; 20(9):964–9. doi:10.1016/S1053-2498(01)00293-5.

Naito E., et al. Thiamine-responsive pyruvate dehydrogenase deficiency in two patients caused by a point mutation (F205L and L216F) within the thiamine pyrophosphate binding region. *Biochim Biophys Acta.* 2002 Oct 9;1588(1):79–84. doi:10.1016/S0925-4439(02)00142-4.

Okada H., et al. Vitamin B6 supplementation can improve peripheral polyneuropathy in patients with chronic renal failure on high-flux haemodialysis and human recombinant erythropoietin. *Nephrol Dial Transplant.* 2000 Sep; 15(9):1410–3. doi:10.1093/ndt/15.9.1410.

Pomero F., et al. Benfotiamine is similar to thiamine in correcting endothelial cell defects induced by high glucose. *Acta Diabetol.* 2001; 38(3):135–8.

Sasaki Y., Araki T., Milbrandt J. Stimulation of nicotinamide adenine dinucleotide biosynthetic pathways delays axonal degeneration after axotomy. *J Neurosci.* 2006 Aug 16; 26(33):8484–91. doi:10.1523/JNEUROSCI.2320-06.2006.

Sato Y., et al. Mitochondrial myopathy and familial thiamine deficiency. *Muscle Nerve*. 2000 Jul; 23(7):1069–75. doi:10.1002/1097-4598(200007)23:7<1069::AID-MUS9>3.0.CO;2-0.

Sauve A. A. NAD⁺ and vitamin B3: from metabolism to therapies. *J Pharmacol Exp Ther*. 2008 Mar; 324(3):883–93. Epub 2007 Dec 28. doi:10.1124/jpet.107.120758.

Scholte H. R., et al. Riboflavin-responsive complex I deficiency. *Biochim Biophys Acta*. 1995 May 24; 1271(1):75–83. doi:10.1016/0925-4439(95)00013-T.

Sheline C. T., et al. Cofactors of mitochondrial enzymes attenuate copper-induced death in vitro and in vivo. *Ann Neurol*. 2002 Aug; 52(2):195–204. doi:10.1002/ana.10276.

Subramanian V. S., et al. Mitochondrial uptake of thiamin pyrophosphate: physiological and cell biological aspects. *PLoS One*. 2013 Aug 30; 8(8):e73503. doi:10.1371/journal.pone.0073503.

Tahiliani A. G., Beinlich C. J. Pantothenic acid in health and disease. *Vitam Horm*. 1991 Feb; 46: 165–228. doi:10.1016/S0083-6729(08)60684-6.

Tempel W., et al. Nicotinamide riboside kinase structures reveal new pathways to NAD⁺. *PLoS Biol*. 2007 Oct 2; 5(10):e263. doi:10.1371/journal.pbio.0050263

Togay-Isikay C., Yigit A., Mutluer N. Wernicke's encephalopathy due to hyperemesis gravidarum: an under-recognised condition. *Aust NZJ Obstet Gynaecol*. 2001 Nov; 41(4): 453–6. doi:10.1111/j.1479-828X.2001.tb01330.

Watanabe F. Vitamin B12 sources and bioavailability. *Exp Biol Med (Maywood)*. 2007 Nov; 232(10):1266–74. doi:10.3181/0703-MR-67.

Yang T., Chan N. Y., Sauve A. A. Syntheses of nicotinamide riboside and derivatives: effective agents for increasing nicotinamide adenine dinucleotide concentrations in mammalian cells. *J Med Chem*. 2007 Dec 27;50(26):6458–61. Epub 2007 Dec 6. doi:10.1021/jm701001c.

Youssef J. A., Song W. O., Badr M. Z. Mitochondrial, but not peroxisomal, beta-oxidation of fatty acids is conserved in coenzyme A-deficient rat liver. *Mol Cell Biochem*. 1997 Oct; 175(1–2):37–42.

Железо

Atamna H. Heme, iron, and the mitochondrial decay of ageing. *Aging Res Rev.* 2004 Jul; 3(3):303–18. doi:10.1016/j.arr.2004.02.002

Atamna H., et al. Heme deficiency may be a factor in the mitochondrial and neuronal decay of aging. *Proc Natl Acad Sci U S A.* 2002 Nov 12; 99(23):14807–12. Epub 2002 Nov 4. doi:10.1073/pnas.192585799.

Stoltzfus R. J. Iron deficiency: global prevalence and consequences. *Food Nutr Bull.* 2003 Dec; 24(4 Suppl):S99–103. doi:10.1177/15648265030244S206.

Ресвератрол и птеростильбен

Alcaín F. J., Villalba J. M. Sirtuin activators. *Expert Opin Ther Pat.* 2009 Apr; 19(4):403–14. doi:10.1517/13543770902762893.

Alosi J. A., et al. Pterostilbene inhibits breast cancer in vitro through mitochondrial depolarization and induction of caspase-dependent apoptosis. *J Surg Res.* 2010 Jun 15; 161(2):195–201. Epub 2009 Aug 18. doi:10.1016/j.jss.2009.07.027.

Bagchi D., et al. Molecular mechanisms of cardioprotection by a novel grape seed proanthocyanidin extract. *Mutat Res.* 2003 Feb–Mar; 523–524:87–97. doi:10.1016/S0027-5107(02)00324-X.

Baur J. A., et al. Resveratrol improves health and survival of mice on a high-calorie diet. *Nature.* 2006 Nov 16; 444(7177):337–42. doi:10.1038/nature05354.

Chiou Y. S., et al. Pterostilbene is more potent than resveratrol in preventing azoxymethane (AOM)-induced colon tumorigenesis via activation of the NF-E2-related factor 2 (Nrf2) mediated antioxidant signaling pathway. *J Agric Food Chem.* 2011 Mar 23; 59(6):2725–33. Epub 2011 Feb 28. doi:10.1021/jf2000103.

Joseph J. A., et al. Cellular and behavioral effects of stilbene resveratrol analogues: implications for reducing the deleterious effects of aging. *J Agric Food Chem.* 2008; 56(22):10544–51. doi:10.1021/jf802279h.

Lagouge M., et al. Resveratrol improves mitochondrial function and protects against metabolic disease by activating SIRT1 and PGC-1alpha. *Cell*. 2006 Dec 15; 127(6):1109–22. doi:10.1016/j.cell.2006.11.013.

Li Y. G., et al. Resveratrol protects cardiomyocytes from oxidative stress through SIRT1 and mitochondrial biogenesis signaling pathways. *Biochem Biophys Res Commun*. 2013 Aug 23;438(2):270–6. Epub 2013 Jul 24. doi:10.1016/j.bbrc.2013.07.042.

Lin V. C., et al. Activation of AMPK by pterostilbene suppresses lipogenesis and cell-cycle progression in p53 positive and negative human prostate cancer cells. *J Agric Food Chem*. 2012 Jun 27; 60(25):6399–407. Epub 2012 Jun 19. doi:10.1021/jf301499e.

Macicková T., et al. Effect of stilbene derivative on superoxide generation and enzyme release from human neutrophils in vitro. *Interdiscip Toxicol*. 2012 Jun; 5(2):71–5. doi:10.2478 /v10102-012-0012-7.

Meng X. L., et al. Effects of resveratrol and its derivatives on lipopolysaccharide-induced microglial activation and their structure-activity relationships. *Chem Biol Interact*. 2008 Jul 10; 174(1):51–9. doi:10.1016/j.cbi.2008.04.015.

Moon D., et al. Pterostilbene induces mitochondrially derived apoptosis in breast cancer cells in vitro. *J Surg Res*. 2013 Apr; 180(2):208–15. Epub 2012 Apr 29. doi:10.1016/j.jss.2012.04.027.

Nutakul W., et al. Inhibitory effects of resveratrol and pterostilbene on human colon cancer cells: a side-by-side comparison. *J Agric Food Chem*. 2011 Oct 26; 59(20):10964–70. doi:10.1021 /jf202846b.

Pan M. H., et al. Pterostilbene induces apoptosis and cell cycle arrest in human gastric carcinoma cells. *J Agric Food Chem*. 2007 Sep 19; 55(19):7777–85. Epub 2007 Aug 16. doi:10.1021/jf071520h.

Pan Z., et al. Identification of molecular pathways affected by pterostilbene, a natural dimethylether analog of resveratrol. *BMC Med Genomics*. 2008 Mar 20; 1:7. doi:10.1186 /1755-8794-1-7.

Pari L., Satheesh M. A. Effect of pterostilbene on hepatic key enzymes of glucose metabolism in streptozotocin- and nicotinamide-induced diabetic rats. *Life Sci*. 2006; 79(7):641–5. doi:10.1016/j.lfs.2006.02.036.

Park E. S., et al. Pterostilbene, a natural dimethylated analog of resveratrol, inhibits rat aortic vascular smooth muscle cell proliferation by blocking Akt-dependent pathway. *Vascul Pharmacol.* 2010 Jul–Aug; 53(1–2):61–7. doi:10.1016/j.vph.2010.04.001.

Pearson K. J., et al. Resveratrol delays age-related deterioration and mimics transcriptional aspects of dietary restriction without extending lifespan. *Cell Metab.* 2008 Aug; 8(2):157–68. doi:10.1016/j.cmet.2008.06.011.

Polley K. R., et al. Influence of exercise training with resveratrol supplementation on skeletal muscle mitochondrial capacity. *Appl Physiol Nutr Metab.* 2016; 41(1):26–32. doi:10.1139/apnm-2015-0370.

Priego S., et al. Natural polyphenols facilitate elimination of HT-29 colorectal cancer xenografts by chemoradiotherapy: a Bcl-2- and superoxide dismutase 2-dependent mechanism. *Mol Cancer Ther.* 2008 Oct; 7(10):3330–42. doi:10.1158/1535-7163.MCT-08-0363.

Remsberg C. M., et al. Pharmacometrics of pterostilbene: preclinical pharmacokinetics and metabolism, anticancer, antiinflammatory, antioxidant and analgesic activity. *Phytother Res.* 2008 Feb; 22(2):169–79. doi:10.1002/ptr.2277.

Rimando A. M., et al. Pterostilbene, a new agonist for the peroxisome proliferator-activated receptor α -Isoform, lowers plasma lipoproteins and cholesterol in hypercholesterolemic hamsters. *J Agric Food Chem.* 2005; 53:3403–7. doi:10.1021/jf0580364.

Siva B., et al. Effect of polyphenolics extracts of grape seeds (GSE) on blood pressure (BP) in patients with the metabolic syndrome (MetS). *FASEB J.* 2006; 20:A305.

Wang J., et al. Grape-derived polyphenolics prevent A β oligomerization and attenuate cognitive deterioration in a mouse model of Alzheimer's disease. *J Neurosci.* 2008 Jun 18; 28(25):6388–92. doi:10.1523/JNEUROSCI.0364-08.2008.

Williams C. M., et al. Blueberry-induced changes in spatial working memory correlate with changes in hippocampal CREB phosphorylation and brain-derived neurotrophic factor (BDNF) levels. *Free Radic Biol Med.* 2008 Aug 1; 45(3):295–305. doi:10.1016/j.freeradbiomed.2008.04.008.

Youdim K. A., et al. Short-term dietary supplementation of blueberry polyphenolics: beneficial effects on aging brain performance and peripheral tissue function. *Nutr Neurosci.* 2000 Jul 13;3:383–97. doi:10.1080/1028415X.2000.11747338.

Кетогенная диета и ограничение калорий

Anderson R. M., et al. Manipulation of a nuclear NAD⁺ salvage pathway delays aging without altering steady-state NAD⁺ levels. *J Biol Chem.* 2002 May 24;277(21):18881–90. doi:10.1074/jbc.M111773200.

Araki T., Sasaki Y., Milbrandt J. Increased nuclear NAD biosynthesis and SIRT1 activation prevent axonal degeneration. *Science.* 2004 Aug 13; 305(5686):1010–3. doi:10.1126/science.1098014.

Campbell M. K., Farrell, S. O. *Biochemistry.* 5th edition. Pacific Grove, Thomson Brooks/Cole; 2006. 579 p.

Carrière A., et al. Browning of white adipose cells by intermediate metabolites: an adaptive mechanism to alleviate redox pressure. *Diabetes.* 2014 Oct; 63(10):3253–65. Epub 2014 May 1. doi:10.2337/db13-1885. Castello L, et al. Calorie restriction protects against age-related rat aorta sclerosis. *FASEB J.* 2005 Nov; 19(13):1863–5. Epub 2005 Sep 8. doi:10.1096/fj.04-2864fje. Cohen HY, et al. Calorie restriction promotes mammalian cell survival by inducing the SIRT1 deacetylase. *Science.* 2004 Jul 16; 305(5682):390–2. doi:10.1126/science.1099196. Colman RJ, et al. Caloric restriction reduces age-related and all-cause mortality in rhesus monkeys. *Nat Commun.* 2014 Apr 1; 5:3557. doi:10.1038/ncomms4557.

Estrada N. M., Isokawa M. Metabolic demand stimulates CREB signaling in the limbic cortex: implication for the induction of hippocampal synaptic plasticity by intrinsic stimulus for survival. *Front Syst Neurosci.* 2009 Jun 9; 3:5. doi:10.3389/neuro.06.005.2009.

Guarente L., Picard F. Calorie restriction — the SIR2 connection. *Cell.* 2005 Feb 25; 120(4): 473–82. doi:10.1016/j.cell.2005.01.029.

Hasselbalch S. G., et al. Brain metabolism during short-term starvation in humans. *J Cereb Blood Flow Metab.* 1994 Jan; 14(1):125–31. doi:10.1038/jcbfm.1994.17.

Ivanova D. G., Yankova T. M. The free radical theory of aging in search of a strategy for increasing life span. *Folia Med (Plovdiv)*. 2013 Jan–Mar; 55(1):33–41. doi:10.2478/folmed-2013-0003.

Jarrett S. G., et al. The ketogenic diet increases mitochondrial glutathione levels. *J Neurochem*. 2008 Aug; 106(3):1044–51. doi:10.1111/j.1471-4159.2008.05460.x. Epub 2008 May 5.

Jung K. J., et al. The redox-sensitive DNA binding sites responsible for age-related downregulation of SMP30 by ERK pathway and reversal by calorie restriction. *Antioxid Redox Signal*. 2006 Mar–Apr; 8(3–4):671–80. doi:10.1089/ars.2006.8.671.

Kashiwaya Y., et al. D-b-hydroxybutyrate protects neurons in models of Alzheimer's and Parkinson's disease. *Proc Natl Acad Sci USA*. 2000 May 9; 97(10):5440–4. doi:10.1073/pnas.97.10.5440.

Kodde I. F., et al. Metabolic and genetic regulation of cardiac energy substrate preference. *Comp Biochem Physiol A Mol Integr Physiol*. 2007 Jan; 146(1):26–39. Epub 2006 Oct 3. doi:10.1016/j.cbpa.2006.09.014.

Laffel L. Ketone bodies: a review of physiology, pathophysiology and application of monitoring to diabetes. *Diabetes Metab Res Rev*. 1999 Nov–Dec; 15(6):412–26. doi:10.1002/(SICI)1520-7560(199911/12)15:6<412::AID-DMRR72>3.0.CO;2-8.

Lim E. L., et al. Reversal of type 2 diabetes: normalisation of beta cell function in association with decreased pancreas and liver triacylglycerol. *Diabetologia*. 2011 Oct; 54(10):2506–14. Epub 2011 Jun 9. doi:10.1007/s00125-011-2204-7.

Lin S. J., et al. Calorie restriction extends yeast life span by lowering the level of NADH. *Genes Dev*. 2004 Jan 1; 18(1):12–6. doi:10.1101/gad.1164804.

Mattson M. P., Chan S. L., Duan W. Modification of brain aging and neurodegenerative disorders by genes, diet, and behavior. *Physiol Rev*. 2002 Jul; 82(3):637–72. doi:10.1152/physrev.00004.2002.

McInnes N., et al. Piloting a remission strategy in type 2 diabetes: results of a randomized controlled trial. *J Clin Endocrinol Metab*. 2017 May 1; 102(5):1596–1605. Epub 2017 Mar 15. doi:10.1210/jc.2016-3373.

Mercken E. M., et al. Calorie restriction in humans inhibits the PI3K/AKT pathway and induces a younger transcription profile. *Aging Cell.* 2013 Aug; 12(4):645–51. Epub 2013 Apr 20. doi:10.1111/accel.12088.

Picard F., et al. Sirt 1 promotes fat mobilization in white adipocytes by repressing PPARgamma. *Nature.* 2004 Jun 17; 429(6993):771–6. doi:10.1038/nature02583.

Prins M. L. Cerebral metabolic adaptation and ketone metabolism after brain injury. *J Cereb Blood Flow Metab.* 2008 Jan; 28(1):1–16. Epub 2007 Aug 8. doi:10.1038/sj.jcbfm.9600543.

Revollo J. R., Grimm A. A., Imai S. The NAD biosynthesis pathway mediated by nicotinamide phosphoribosyltransferase regulates Sir2 activity in mammalian cells. *J Biol Chem.* 2004 Dec 3; 279(49):50754–63. doi:10.1074/jbc.M408388200.

Rose G., et al. Variability of the SIRT3 gene, human silent information regulator Sir2 homologue, and survivorship in the elderly. *Exp Gerontol.* 2003 Oct; 38(10):1065–70. doi:10.1016/S0531-5565(03)00209-2.

Sato K., et al. Insulin, ketone bodies, and mitochondrial energy transduction. *FASEB J.* 1995 May; 9(8):651–8.

Scheibye-Knudsen M., et al. A high-fat diet and NAD(+) activate Sirt1 to rescue premature aging in cockayne syndrome. *Cell Metab.* 2014 Nov 4; 20(5):840–55. Epub 2014 Nov 4. doi:10.1016/j.cmet.2014.10.005.

Sharman M. J., et al. A ketogenic diet favorably affects serum biomarkers for cardiovascular disease in normal-weight young men. *J Nutr.* 2002 Jul; 132(7):1879–85.

Sort R., et al. Ketogenic diet in 3 cases of childhood refractory status epilepticus. *Eur J Paediatr Neurol.* 2013 Nov; 17(6):531–6. Epub 2013 Jun 7. doi:10.1016/j.ejpn.2013.05.001.

Spindler S. R. Caloric restriction: from soup to nuts. *Aging Res Rev.* 2010 Jul; 9(3):324–53. doi:10.1016/j.arr.2009.10.003.

VanItallie T. B., Nufert T. H. Ketones: metabolism's ugly duckling. *Nutr Rev.* 2003 Oct; 61(10): 327–41. doi:10.1301/nr.2003.oct.327-341.

Veech R. L., et al. Ketone bodies, potential therapeutic uses. *IUBMB Life.* 2001 Apr; 51(4): 241–7. doi:10.1080/152165401753311780.

Wang S. P., et al. Metabolism as a tool for understanding human brain evolution: lipid energy metabolism as an example. *J Hum Evol.* 2014 Dec; 77:41–9. Epub 2014 Dec 6. doi:10.1016 /j.jhevol.2014.06.013.

Wegman M. P., et al. Practicality of intermittent fasting in humans and its effect on oxidative stress and genes related to aging and metabolism. *Rejuvenation Res.* 2015 Apr; 18(2):162–72. doi:10.1089/rej.2014.1624.

Wood J. G., et al. Sirtuin activators mimic caloric restriction and delay aging in metazoans. *Nature.* 2004 Aug 5; 430(7000):686–9. doi:10.1038/nature02789.

Массаж и гидротерапия

Boon M. R., et al. Brown adipose tissue: the body's own weapon against obesity? *Ned Tijdschr Geneeskd.* 2013; 157(20):A5502.

Crane J. D., et al. Massage therapy attenuates inflammatory signaling after exercise-induced muscle damage. *Sci Transl Med.* 2012 Feb 1;4(119):119ra13. doi:10.1126/scitranslmed .3002882.

Lee P., et al. Temperature-acclimated brown adipose tissue modulates insulin sensitivity in humans. *Diabetes.* 2014 Nov; 63(11):3686–98. Epub 2014 Jun 22. doi:10.2337/db14-0513.

Lo K. A, Sun L. Turning WAT into BAT: a review on regulators controlling the browning of white adipocytes. *Biosci Rep.* 2013 Sep 6; 33(5):e00065. Epub Jul 30.

van der Lans A. A, et al. Cold acclimation recruits human brown fat and increases nonshivering thermogenesis. *J Clin Invest.* 2013 Aug;123(8):3395–403. Epub 2013 Jul 15. doi:10.1172 /JCI68993.

Физическая активность и специальные упражнения

Alf D., Schmidt M. E., Siebrecht S. C. Ubiquinol supplementation enhances peak power production in trained athletes: a double-blind, placebo controlled study. *J Int Soc Sports Nutr.* 2013 Apr 29;10(1):24. Epub. doi:10.1186/1550-2783-10-24.

Alzheimer's Association International Conference (AAIC); 2012 Jul 14–19; Vancouver, BC. *Alzheimers Dement.* Abstract F1-03-01.

Alzheimer's Association International Conference (AAIC); 2012 Jul 14–19; Vancouver, BC. *Alzheimers Dement. Abstracts* FI-03-02.

Alzheimer's Association International Conference (AAIC); 2012 Jul 14–19; Vancouver, BC. *Alzheimers Dement. Abstracts* P1-109.

Alzheimer's Association International Conference (AAIC); 2012 Jul 14–19; Vancouver, BC. *Alzheimers Dement. Abstracts* P1-121.

Barrès R., et al. Acute exercise remodels promoter methylation in human skeletal muscle. *Cell Metab.* 2012 Mar 7; 15(3):405–11. doi:10.1016/j.cmet.2012.01.001.

Bergeron R., et al. Chronic activation of AMP kinase results in NRF-1 activation and mitochondrial biogenesis. *Am J Physiol Endocrinol Metab.* 2001 Dec; 281(6):E1340–E1346.

Brown W. J., Pavey T., Bauman A. E. Comparing population attributable risks for heart disease across the adult lifespan in women. *Br J Sports Med.* 2015 Jul 29. Epub 2014 May 8. doi:10.1136/bjsports-2015-095213.

Campbell P., et al. Associations of recreational physical activity and leisure time spent sitting with colorectal cancer survival. *J Clin Oncol.* 2013 Mar 1; 31(7):876–85. doi:10.1200/JCO.2012.45.9735.

Clanton T. L. Hypoxia-induced reactive oxygen species formation in skeletal muscle. *J Appl Physiol* (1985). 2007 Jun; 102(6):2379–88. doi:10.1152/jappphysiol.01298.2006.

Díaz-Castro J., et al. Coenzyme Q(10) supplementation ameliorates inflammatory signaling and oxidative stress associated with strenuous exercise. *Eur J Nutr.* 2012 Oct; 51(7):791–9. Epub 2011 Oct 12. doi:10.1007/s00394-011-0257-5.

Erickson K. I., et al. Exercise training increases size of hippocampus and improves memory. *Proc Natl Acad Sci USA.* 2011 Feb 15; 108(7):3017–22. Epub 2011 Jan 31. doi:10.1073/pnas.1015950108.

Gioscia-Ryan R. A., et al. Voluntary aerobic exercise increases arterial resilience and mitochondrial health with aging in mice. *Aging (Albany NY).* 2016 Nov 22; 8(11):2897–2914. doi:10.18632/aging.101099.

Gram M., Dahl R., Dela F. Physical inactivity and muscle oxidative capacity in humans. *Eur J Sport Sci.* 2014; 14(4):376–83. Epub 2013 Aug 1. doi:10.1080/17461391.2013.823466.

Greggio C., et al. Enhanced respiratory chain supercomplex formation in response to exercise in human skeletal muscle. *Cell Metab.* 2017 Feb 7; 25(2):301–11. Epub 2016 Dec 1. doi:10.1016/j.cmet.2016.11.004.

Hood D. A. Contractile activity-induced mitochondrial biogenesis in skeletal muscle [invited review]. *J Appl Physiol* (1985). 2001 Mar; 90(3):1137–57.

Johnson M. L., et al. Chronically endurance-trained individuals preserve skeletal muscle mitochondrial gene expression with age but differences within age groups remain. *Physiol Rep.* 2014 Dec; 2(12):e12239. Epub 2014 Dec 18. doi:10.14814/phy2.12239.

Kang C., et al. Exercise training attenuates aging-associated mitochondrial dysfunction in rat skeletal muscle: role of PGC-1 α . *Exp Gerontol.* 2013 Nov; 48(11):1343–50. Epub 2013 Aug 29. doi:10.1016/j.exger.2013.08.004.

Koltai E., et al. Age-associated declines in mitochondrial biogenesis and protein quality control factors are minimized by exercise training. *Am J Physiol Regul Integr Comp Physiol.* 2012 Jul 15; 303(2):R127–R134. Epub 2012 May 9. doi:10.1152/ajpregu.00337.2011.

Konopka A. R., et al. Markers of human skeletal muscle mitochondrial biogenesis and quality control: effects of age and aerobic exercise training. *J Gerontol A Biol Sci Med Sci.* 2014 Apr; 69(4):371–8. Epub 2013 Jul 20. doi:10.1093/gerona/glt107.

Konopka A. R., et al. Defects in mitochondrial efficiency and H₂O₂ emissions in obese women are restored to a lean phenotype with aerobic exercise training. *Diabetes.* 2015 Jun; 64(6):2104–15. doi:10.2337/db14-1701.

Lawson E. C., et al. Aerobic exercise protects retinal function and structure from light-induced retinal degeneration. *J Neurosci.* 2014 Feb 12; 34(7):2406–12. doi:10.1523/JNEUROSCI.2062-13.2014.

Liu C. C., et al. Lycopene supplementation attenuated xanthine oxidase and myeloperoxidase activities in skeletal muscle tissues of rats after exhaustive exercise. *Br J Nutr.* 2005; 94: 595–601. doi:10.1079/BJN20051541.

Marcelino T. B., et al. Evidences that maternal swimming exercise improves antioxidant defenses and induces mitochondrial biogenesis in brain of young Wistar rats. *Neuroscience.* 2013 Aug 29; 246:28–39. Epub 2013 Apr 29. doi:10.1016/j.neuroscience.2013.04.043.

- Melov S., et al.* Resistance exercise reverses aging in human skeletal muscle. PLoS One. 2007 May 23; 2(5):e465. doi:10.1371/journal.pone.0000465.
- Menshikova E. V., et al.* Effects of exercise on mitochondrial content and function in aging human skeletal muscle. J Gerontol A Biol Sci Med Sci. 2006 Jun; 61(6):534–40.
- Nikolaidis M. G., Jamurtas A. Z.* Blood as a reactive species generator and redox status regulator during exercise. Arch Biochem Biophys. 2009 Oct 15; 490(2):77–84. doi:10.1016/j.abb .2009.08.015.
- Powers S. K., Jackson M. J.* Exercise-induced oxidative stress: cellular mechanisms and impact on muscle force production. Physiol Rev. 2008 Oct; 88(4):1243–76. doi:10.1152/physrev .00031.2007.
- Reichhold S., et al.* Endurance exercise and DNA stability: is there a link to duration and intensity? Mutat Res. 2009 Jul–Aug; 682(1):28–38. doi:10.1016/j.mrrev.2009.02.002.
- Richardson R. S., et al.* Myoglobin O₂ desaturation during exercise: evidence of limited O₂ transport. J Clin Invest. 1995 Oct; 96(4):1916–26. doi:10.1172/JCI118237.
- Safdar A., et al.* Exercise increases mitochondrial PGC-1 α content and promotes nuclear-mitochondrial cross-talk to coordinate mitochondrial biogenesis. J Biol Chem. 2011 Mar 25;286(12):10605–17. Epub 2011 Jan 18. doi:10.1074/jbc.M110.211466.
- Schnohr P, et al.* Longevity in male and female joggers: the Copenhagen city heart study. Am J Epidemiol. 2013 Apr 1; 177(7):683–9. Epub 2013 Feb 28. doi:10.1093/aje/kws301.
- Siddiqui N. I., Nessa A., Hossain M. A.* Regular physical exercise: way to healthy life. Mymensingh Med J. 2010 Jan; 19(1):154–8.
- Steiner J. L., et al.* Exercise training increases mitochondrial biogenesis in the brain. J Appl Physiol (1985). 2011 Oct; 111(4):1066–71. Epub 2011 Aug 4. doi:10.1152/jappphysiol.00343 .2011.
- Suzuki K., et al.* Circulating cytokines and hormones with immunosuppressive but neutrophil-priming potentials rise after endurance exercise in humans. Eur J Appl Physiol. 2000 Jan;81: 281–7.

Toledo F. G., et al. Effects of physical activity and weight loss on skeletal muscle mitochondria and relationship with glucose control in type 2 diabetes. *Diabetes*. 2007 Aug; 56(8):2142–7. Epub 2007 May 29. doi:10.2337/db07-0141.

Urso M. L., Clarkson P. M. Oxidative stress, exercise, and antioxidant supplementation. *Toxicology*. 2003; 189(1–2):41–54. doi:10.1016/S0300-483X(03)00151-3.

Yuki A., et al. Relationship between physical activity and brain atrophy progression. *Med Sci Sports Exerc*. 2012 Dec; 44(12):2362–8. doi:10.1249/MSS.0b013e3182667d1d.

Zong H., et al. AMP kinase is required for mitochondrial biogenesis in skeletal muscle in response to chronic energy deprivation. *Proc Natl Acad Sci USA*. 2002 Dec 10; 99(25): 15983–7. Epub 2002 Nov 20. doi:10.1073/pnas.252625599.