

Supporting Healthy Estrogen Metabolism During Bioidentical Hormone Replacement Therapy

by Chris D. Meletis, ND, and Kimberly Wilkes

References

1. Bouguen G, et al. Intestinal steroidogenesis. *Steroids*. 2015 Nov;103:64-71.
2. Oakley OR, et al. Estradiol Synthesis in Gut-Associated Lymphoid Tissue: Leukocyte Regulation by a Sexually Monomorphic System. *Endocrinology*. 2016 Dec;157(12):4579-87.
3. Diebel ME, et al. Estrogen modulates intestinal mucus physiochemical properties and protects against oxidant injury. *J Trauma Acute Care Surg*. 2015 Jan;78(1):94-9.
4. Mulak A, et al. Sex hormones in the modulation of irritable bowel syndrome. *World J Gastroenterol*. 2014 Mar 14;20(10):2433-48.
5. Triadafilopoulos G, et al. Bowel dysfunction in postmenopausal women. *Women Health*. 1998;27(4):55-66.
6. Olafsdottir LB, et al. Natural history of irritable bowel syndrome in women and dysmenorrhea: a 10-year follow-up study. *Gastroenterol Res Pract*. 2012;2012:534204.
7. Fuhrman BJ, et al. Associations of the fecal microbiome with urinary estrogens and estrogen metabolites in postmenopausal women. *J Clin Endocrinol Metab*. 2014 Dec;99(12):4632-40.
8. Heinemann C, Reid G. Vaginal microbial diversity among postmenopausal women with and without hormone replacement therapy. *Can J Microbiol*. 2005 Sep;51(9):777-81.
9. Poutahidis T, et al. Probiotic microbes sustain youthful serum testosterone levels and testicular size in aging mice. *PLoS One*. 2014 Jan 2;9(1):e84877.
10. McNamara LM. Perspective on post-menopausal osteoporosis: establishing an interdisciplinary understanding of the sequence of events from the molecular level to whole bone fractures. *J R Soc Interface*. 2010 Mar 6;7(44):353-72.
11. Riggs BL, et al. Sex steroids and the construction and conservation of the adult skeleton. *Endocr Rev*. 2002 Jun;23(3):279-302.
12. Britton RA, et al. Probiotic L. reuteri treatment prevents bone loss in a menopausal ovariectomized mouse model. *J Cell Physiol*. 2014 Nov;229(11):1822-30.
13. Yan J, et al. Gut microbiota induce IGF-1 and promote bone formation and growth. *Proc Natl Acad Sci U S A*. 2016 Nov 22;113(47):E7554-63.
14. Arnarson A, et al. Insulin-Like Growth Factor-1 and Resistance Exercise in Community Dwelling Old Adults. *J Nutr Health Aging*. 2015 Oct;19(8):856-60.
15. Okereke O, et al. Plasma IGF-I levels and cognitive performance in older women. *Neurobiol Aging*. 2007 Jan;28(1):135-42.
16. Gaya P, et al. Phytoestrogen Metabolism by Adult Human Gut Microbiota. *Molecules*. 2016 Aug 9;21(8). pii: E1034.
17. Landete JM, et al. Bioactivation of Phytoestrogens: Intestinal Bacteria and Health. *Crit Rev Food Sci Nutr*. 2016 Aug 17;56(11):1826-43.
18. Seeram NP, et al. Pomegranate ellagitannin-derived metabolites inhibit prostate cancer growth and localize to the mouse prostate gland. *J Agric Food Chem*. 2007 Sep 19;55(19):7732-7.
19. Chan YH, et al. Dietary intake of phytoestrogen is associated with increased circulating endothelial progenitor cells in patients with cardiovascular disease. *Eur J Cardiovasc Prev Rehabil*. 2011 Jun;18(3):360-8.
20. Yohwan Y, et al. Isoflavones from phytoestrogens and colorectal cancer risk: A nested case-control study within the Korean Multicenter Cancer Cohort. [abstract 4823]. In: Proceedings of the 104th Annual Meeting of the American Association for Cancer Research; 2013 Apr 6-10; Washington, DC. Philadelphia (PA): AACR; *Cancer Res*. 2013;73(8 Suppl).
21. Poluzzi E, et al. Phytoestrogens in postmenopause: the state of the art from a chemical, pharmacological and regulatory perspective. *Curr Med Chem*. 2014;21(4):417-36.
22. Setchell KD, et al. The clinical importance of the metabolite equol—a clue to the effectiveness of soy and its isoflavones. *J Nutr*. 2002 Dec;132(12):3577-84.
23. Wallace BD, et al. Structure and Inhibition of Microbiome β -Glucuronidases Essential to the Alleviation of Cancer Drug Toxicity. *Chem Biol*. 2015 Sep 17;22(9):1238-49.
24. Pellock SJ, Redinbo MR. Glucuronides in the Gut: Sugar-Driven Symbioses Between Microbe and Host. *J Biol Chem*. 2017 Apr 7. pii: jbc.R116.767434.
25. Nowak A, .ewska Kžiš he heterocyclic aromatic glucosidase activity and human fecal water genotoxicity in the presence of probiotic lactobacilli and t- β Glucuronidase and- β .amine IQ in vitro *Environ Toxicol Pharmacol*. 2014 Jan;37(1):66-73.
26. Kajander K, et al. Effects of multispecies probiotic supplementation on intestinal microbiota in irritable bowel syndrome. *Aliment Pharmacol Ther*. 2007 Aug 1;26(3):463-73.
27. Hijová E, et al. Ability of Lactobacillus plantarum LS/07 to modify intestinal enzymes activity in chronic diseases prevention. *Acta Biochim Pol*. 2017;64(1):113-116.
28. No authors listed. Calcium-D-glucarate. *Altern Med Rev*. 2002 Aug;7(4):336-9.
29. Walaszek Z, et al. Dietary glucarate as anti-promoter of 7,12-dimethylbenz[a]anthracene-induced mammary tumorigenesis. *Carcinogenesis*. 1986 Sep;7(9):1463-6.
30. Hanausek M, et al. Detoxifying cancer causing agents to prevent cancer. *Integr Cancer Ther*. 2003 Jun;2(2):139-44.
31. Zoltascek R, et al. Dietary D-glucarate effects on the biomarkers of inflammation during early post-initiation stages of benzo[a]pyrene-induced lung tumorigenesis in A/J mice. *Oncol Lett*. 2011 Jan;2(1):145-54.
32. Telang NT, et al. Induction by estrogen metabolite 16 alpha-hydroxyestrone of genotoxic damage and aberrant proliferation in mouse mammary epithelial cells. *J Natl Cancer Inst*. 1992 Apr 15;84(8):634-8.
33. Bradlow HL, et al. 2-hydroxyestrone: the 'good' estrogen. *J Endocrinol*. 1996 Sep;150 Suppl:S259-65.
34. Higdon JV, et al. Cruciferous vegetables and human cancer risk: epidemiologic evidence and mechanistic basis. *Pharmacol Res*. 2007 Mar;55(3):224-36.
35. Cauley JA, et al. Estrogen metabolites and the risk of breast cancer in older women. *Epidemiology*. 2003 Nov;14(6):740-4.
36. Ursin G, et al. Urinary 2-hydroxyestrone/16alpha-hydroxyestrone ratio and risk of breast cancer in postmenopausal women. *J Natl Cancer Inst*. 1999 Jun 16;91(12):1067-72.
37. Ho GH, et al. Urinary 2/16 alpha-hydroxyestrone ratio: correlation with serum insulin-like growth factor binding protein-3 and a potential biomarker of breast cancer risk. *Ann Acad Med Singapore*. 1998 Mar;27(2):294-9.
38. Kabat GC, et al. Urinary estrogen metabolites and breast cancer: a case-control study. *Cancer Epidemiol Biomarkers Prev*. 1997 Jul;6(7):505-9.
39. Schneider J, et al. Abnormal oxidative metabolism of estradiol in women with breast cancer. *Proc Natl Acad Sci U S A*. 1982 May;79(9):3047-51.
40. Sampson JN, et al. Association of Estrogen Metabolism with Breast Cancer Risk in Different Cohorts of Postmenopausal Women. *Cancer Res*. 2017 Feb 15;77(4):918-25.
41. Tworoger SS, et al. Association of CYP17, CYP19, CYP1B1, and COMT polymorphisms with serum and urinary sex hormone concentrations in postmenopausal women. *Cancer Epidemiol Biomarkers Prev*. 2004 Jan;13(1):94-101.
42. Bradlow HL, et al. Long-term responses of women to indole-3-carbinol or a high fiber diet. *Cancer Epidemiol Biomarkers Prev*. 1994 Oct-Nov;3(7):591-5.
43. Michnovicz JJ, et al. Changes in levels of urinary estrogen metabolites after oral indole-3-carbinol treatment in humans. *J Natl Cancer Inst*. 1997 May 21;89(10):718-23.
44. Wong GY, et al. Dose-ranging study of indole-3-carbinol for breast cancer prevention. *J Cell Biochem Suppl*. 1997;28-29:111-6.
45. Dalessandri KM, et al. Pilot study: effect of 3,3'-diindolylmethane supplements on urinary hormone metabolites in postmenopausal women with a history of early-stage breast cancer. *Nutr Cancer*. 2004;50(2):161-7.
46. Rajoria S, et al. 3,3'-diindolylmethane modulates estrogen metabolism in patients with thyroid proliferative disease: a pilot study. *Thyroid*. 2011 Mar;21(3):299-304.
47. Del Priore G, et al. Oral diindolylmethane (DIM): pilot evaluation of a nonsurgical treatment for cervical dysplasia. *Gynecol Oncol*. 2010 Mar;116(3):464-7.

48. Ramalho-Santos J, Amaral S. Mitochondria and mammalian reproduction. *Mol Cell Endocrinol*. 2013 Oct 15;379(1-2):74-84.
49. Strushkevich N, et al. Structural basis for pregnenolone biosynthesis by the mitochondrial monooxygenase system. *Proc Natl Acad Sci U S A*. 2011 Jun 21;108(25):10139-43.
50. Le B, et al. New targets for increasing endogenous testosterone production: clinical implications and review of the literature. *Andrology*. 2014 Jul;2(4):484-90.
51. Psarra AM, Sekeris CE. Steroid and thyroid hormone receptors in mitochondria. *IUBMB Life*. 2008 Apr;60(4):210-23.
52. Wickramasekera NT, Das GM. Tumor suppressor p53 and estrogen receptors in nuclear-mitochondrial communication. *Mitochondrion*. 2014 May;16:26-37.
53. Vasconsuelo A, et al. Role of 17 β -estradiol and testosterone in apoptosis. *Steroids*. 2011 Nov;76(12):1223-31.
54. Gigli I, Bussmann LE. Exercise and ovarian steroid hormones: their effects on mitochondrial respiration. *Life Sci*. 2001 Feb 16;68(13):1505-14.
55. Klinge CM. Estrogenic control of mitochondrial function and biogenesis. *J Cell Biochem*. 2008 Dec 15;105(6):1342-51.
56. Rosenfeldt F, et al. Coenzyme Q10 therapy before cardiac surgery improves mitochondrial function and in vitro contractility of myocardial tissue. *J Thorac Cardiovasc Surg*. 2005 Jan;129(1):25-32.
57. 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 Mol Biol (Noisy-le-grand)*. 1997 Jul;43(5):741-9.
58. Hagen TM, 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.
59. McMackin CJ, et al. Effect of combined treatment with alpha-Lipoic acid and acetyl-L-carnitine on vascular function and blood pressure in patients with coronary artery disease. *J Clin Hypertens (Greenwich)*. 2007 Apr;9(4):249-55.
60. Nieman DC, et al. Quercetin's influence on exercise performance and muscle mitochondrial biogenesis. *Med Sci Sports Exerc*. 2010 Feb;42(2):338-45.
61. Li X, et al. Protective Effects of Quercetin on Mitochondrial Biogenesis in Experimental Traumatic Brain Injury via the Nrf2 Signaling Pathway. *PLoS One*. 2016 Oct 25;11(10):e0164237.
62. Mukai R, et al. Preventive effect of dietary quercetin on disuse muscle atrophy by targeting mitochondria in denervated mice. *J Nutr Biochem*. 2016 May;31:67-76.
63. Sharma DR, et al. Quercetin protects against aluminium induced oxidative stress and promotes mitochondrial biogenesis via activation of the PGC-1 α signaling pathway. *Neurotoxicology*. 2015 Dec;51:116-37.