

# REPORT

## Innovative Strategies to Combat Kidney Disease

By Julius Goepf, MD

### ADDITIONAL NUTRIENTS THAT MAY BENEFIT CKD

**Folic acid** is well known for its capacity to reduce levels of the metabolite *homocysteine*, which is strongly associated with cardiovascular disease and dramatically elevated in individuals with kidney disease or kidney failure.<sup>94-97</sup>

**Omega-3 fatty acids** have been shown to help correct cardiovascular risk factors<sup>98-100</sup> and to improve kidney function in patients with established kidney disease.<sup>101,102</sup> Research published in 2009 suggests that diets rich in omega-3s may actually *prevent* kidney disease.<sup>103,104</sup>

Through powerful antioxidant effects, **vitamin E** may help prevent CKD onset, and **vitamins E and C** may mitigate development of cardiovascular and other complications in patients with chronic kidney disease.<sup>105-110</sup>



### SUMMARY

Chronic kidney disease (CKD) is rapidly approaching epidemic proportions, with up to **26 million** Americans suffering from some form of kidney disease. Kidneys must filter **200 quarts** of blood every day. The high-pressure and toxin-rich environment to surrounding renal function renders these delicate, highly complex organs especially vulnerable to damage, dysfunction, and disease.

**High blood pressure, elevated blood sugar, NSAIDs** (such as ibuprofen), **certain medications**, and **high-protein diets** are the most common threats to kidney health. The potentially lethal insults they inflict include oxidative stress, production of advanced glycation and lipoxidation end products (AGEs and ALEs), inflammation, and an excessive filtration burden that taxes renal function over time.

Nutrients such as **pyridoxal-5-phosphate (P5P)** fight AGEs and ALEs. **CoQ10, silymarin, resveratrol**, and **lipoic acid** are also clinically supported, potent interventions. Omega-3 fatty acids help quell inflammation, contributing to enhanced kidney health. A host of additional nutrients complement these actions, including folic acid (folate) and vitamins C and E.

*If you have any questions on the scientific content of this article, please call a Life Extension® Health Advisor at 1-866-864-3027.*

---

### References

---

1. Available at: <http://emedicine.medscape.com/article/238798-overview>. Accessed February 18, 2010.
2. Available at: <http://www.usrds.org/adr.htm>. Accessed March 30, 2009.
3. Available at: <http://www.kidney.org/kidneydisease/ckd/index.cfm>. Accessed April 4, 2009.
4. Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS. Prevalence of chronic kidney disease and decreased kidney function in the adult US population: Third National Health and Nutrition Examination Survey. *Am J Kidney Dis.* 2003 Jan;41(1):1-12.
5. Galil AG, Pinheiro HS, Chaoubah A, Costa DM, Bastos MG. Chronic kidney disease increases cardiovascular unfavourable outcomes in outpatients with heart failure. *BMC Nephrol.* 2009 Oct 21;10:31.
6. Voziyan PA, Hudson BG. Pyridoxamine: the many virtues of a maillard reaction inhibitor. *Ann N Y Acad Sci.* 2005 Jun;1043:807-16.

7. Ahmed N, Thornalley PJ. Advanced glycation endproducts: what is their relevance to diabetic complications? *Diabetes Obes Metab.* 2007 May;9(3):233-45.
8. Williams ME. New potential agents in treating diabetic kidney disease: the fourth act. *Drugs.* 2006;66(18):2287-98.
9. Alderson NL, Chachich ME, Frizzell N, et al. Effect of antioxidants and ACE inhibition on chemical modification of proteins and progression of nephropathy in the streptozotocin diabetic rat. *Diabetologia.* 2004 Aug;47(8):1385-95.
10. Metz TO, Alderson NL, Chachich ME, Thorpe SR, Baynes JW. Pyridoxamine traps intermediates in lipid peroxidation reactions in vivo: evidence on the role of lipids in chemical modification of protein and development of diabetic complications. *J Biol Chem.* 2003 Oct 24;278(43):42012-9.
11. Metz TO, Alderson NL, Thorpe SR, Baynes JW. Pyridoxamine, an inhibitor of advanced glycation and lipoxidation reactions: a novel therapy for treatment of diabetic complications. *Arch Biochem Biophys.* 2003 Nov 1;419(1):41-9.
12. Onorato JM, Jenkins AJ, Thorpe SR, Baynes JW. Pyridoxamine, an inhibitor of advanced glycation reactions, also inhibits advanced lipoxidation reactions. Mechanism of action of pyridoxamine. *J Biol Chem.* 2000 Jul 14;275(28):21177-84.
13. Degenhardt TP, Alderson NL, Arrington DD, et al. Pyridoxamine inhibits early renal disease and dyslipidemia in the streptozotocin-diabetic rat. *Kidney Int.* 2002 Mar;61(3):939-50.
14. Alderson NL, Chachich ME, Youssef NN, et al. The AGE inhibitor pyridoxamine inhibits lipemia and development of renal and vascular disease in Zucker obese rats. *Kidney Int.* 2003 Jun;63(6):2123-33.
15. Zheng F, Zeng YJ, Plati AR, et al. Combined AGE inhibition and ACEi decreases the progression of established diabetic nephropathy in B6 db/db mice. *Kidney Int.* 2006 Aug;70(3):507-14.
16. Williams ME, Bolton WK, Khalifah RG, Degenhardt TP, Schotzinger RJ, McGill JB. Effects of pyridoxamine in combined phase 2 studies of patients with type 1 and type 2 diabetes and overt nephropathy. *Am J Nephrol.* 2007;27(6):605-14.
17. Murakoshi M, Tanimoto M, Gohda T, et al. Pleiotropic effect of pyridoxamine on diabetic complications via CD36 expression in KK-Ay/Ta mice. *Diabetes Res Clin Pract.* 2009 Feb;83(2):183-9.
18. Tanimoto M, Gohda T, Kaneko S, et al. Effect of pyridoxamine (K-163), an inhibitor of advanced glycation end products, on type 2 diabetic nephropathy in KK-A(y)/Ta mice. *Metabolism.* 2007 Feb;56(2):160-7.
19. Waanders F, van den Berg E, Nagai R, van Veen I, Navis G, van Goor H. Renoprotective effects of the AGE-inhibitor pyridoxamine in experimental chronic allograft nephropathy in rats. *Nephrol Dial Transplant.* 2008 Feb;23(2):518-24.
20. Nakamura S, Li H, Adijiang A, Pischetsrieder M, Niwa T. Pyridoxal phosphate prevents progression of diabetic nephropathy. *Nephrol Dial Transplant.* 2007 Aug;22(8):2165-74.
21. Kirsten R, Heintz B, Nelson K, et al. Magnesium pyridoxal 5-phosphate glutamate reduces hyperlipidaemia in patients with chronic renal insufficiency. *Eur J Clin Pharmacol.* 1988;34(2):133-7.
22. Gazdikova K, Gvozdjakova A, Kucharska J, Spustova V, Braunova Z, Dzurik R. Malondialdehyde and selected antioxidant plasma levels in conservatively treated patients with kidney diseases. *Bratisl Lek Listy.* 2000;101(9):490-4.
23. Igarashi T, Nakajima Y, Tanaka M, Otake S. Effect of coenzyme Q10 on experimental hypertension in rats and dogs. *J Pharmacol Exp Ther.* 1974 Apr;189(1):149-56.
24. Morotomi Y, Oniki H, Onoyama K, Fukiyama K, Omae T. Effects of coenzyme Q10 on the blood pressure and renal renin content in spontaneously hypertensive rats. *Igaku Kenkyu.* 1975 Nov;45(5):303-8.
25. Lippa S, Colacicco L, Bondanini F, et al. Plasma levels of coenzyme Q(10), vitamin E and lipids in uremic patients on conservative therapy and hemodialysis treatment: some possible biochemical and clinical implications. *Clin Chim Acta.* 2000 Feb 25;292(1-2):81-91.
26. Gazdikova K, Gvozdjakova A, Kucharska J, Spustova V, Braunova Z, Dzurik R. Effect of coenzyme Q10 in patients with kidney diseases. *Cas Lek Cesk.* 2001 May 24;140(10):307-10.

27. Rauscher FM, Sanders RA, Watkins JB, 3rd. Effects of coenzyme Q10 treatment on antioxidant pathways in normal and streptozotocin-induced diabetic rats. *J Biochem Mol Toxicol*. 2001;15(1):41-6.
28. Dlugosz A, Kuzniar J, Sawicka E, et al. Oxidative stress and coenzyme Q10 supplementation in renal transplant recipients. *Int Urol Nephrol*. 2004;36(2):253-8.
29. Available at: <http://kidney.niddk.nih.gov/Kudiseases/pubs/yourkidneys/>. Accessed February 17, 2010.
30. Shlipak MG, Sarnak MJ, Katz R, et al. Cystatin C and the risk of death and cardiovascular events among elderly persons. *N Engl J Med*. 2005 May 19;352(20):2049-60.
31. Levey AS, Stevens LA, Coresh J. Conceptual model of CKD: applications and implications. *Am J Kidney Dis*. 2009 Mar;53(3 Suppl 3):S4-16.
32. Available at:[http://clinicalevidence.bmj.com/ceweb/conditions/knd/2002/2002\\_background.jsp](http://clinicalevidence.bmj.com/ceweb/conditions/knd/2002/2002_background.jsp). Accessed February 17, 2010.
33. Farswan M, Rathod SP, Upaganlawar AB, Semwal A. Protective effect of coenzyme Q10 in simvastatin and gemfibrozil induced rhabdomyolysis in rats. *Indian J Exp Biol*. 2005 Oct 2005;43(10):845-8.
34. Upaganlawar A, Farswan M, Rathod S, Balaraman R. Modification of biochemical parameters of gentamicin nephrotoxicity by coenzyme Q10 and green tea in rats. *Indian J Exp Biol*. 2006 May;44(5):416-8.
35. Post-White J, Ladas EJ, Kelly KM. Advances in the use of milk thistle (*Silybum marianum*). *Integr Cancer Ther*. 2007 Jun;6(2):104-9.
36. Wojcikowski K, Stevenson L, Leach D, Wohlmuth H, Gobe G. Antioxidant capacity of 55 medicinal herbs traditionally used to treat the urinary system: a comparison using a sequential three-solvent extraction process. *J Altern Complement Med*. 2007 Jan-Feb;13(1):103-9.
37. Floersheim GL. Experimental basis for the therapy of *Amanita phalloides* poisoning. *Schweiz Med Wochenschr*. 1978 Feb 11;108(6):185-97.
38. Vogel G, Braatz R, Mengs U. On the nephrotoxicity of alpha-amanitin and the antagonistic effects of silymarin in rats. *Agents Actions*. 1979 Jun;9(2):221-6.
39. Launay-Vacher V, Rey JB, Isnard-Bagnis C, Deray G, Daouphars M, European Society of Clinical Pharmacy Special Interest Group on Cancer C. Prevention of cisplatin nephrotoxicity: state of the art and recommendations from the European Society of Clinical Pharmacy Special Interest Group on Cancer Care. *Cancer Chemother Pharmacol*. 2008 May;61(6):903-9.
40. Machado V, Cabral A, Monteiro P, Goncalves L, Providencia LA. Carvedilol as a protector against the cardiotoxicity induced by anthracyclines (doxorubicin). *Rev Port Cardiol*. 2008 Oct;27(10):1277-96.
41. Yao X, Panichpisal K, Kurtzman N, Nugent K. Cisplatin nephrotoxicity: a review. *Am J Med Sci*. 2007Aug;334(2):115-24.
42. Bokemeyer C, Fels LM, Dunn T, et al. Silibinin protects against cisplatin-induced nephrotoxicity without compromising cisplatin or ifosfamide anti-tumour activity. *Br J Cancer*. 1996 Dec;74(12):2036-41.
43. Gaedeke J, Fels LM, Bokemeyer C, Mengs U, Stolte H, Lentzen H. Cisplatin nephrotoxicity and protection by silibinin. *Nephrol Dial Transplant*. 1996 Jan;11(1):55-62.
44. Karimi G, Ramezani M, Tahoonian Z. Cisplatin nephrotoxicity and protection by milk thistle extract in rats. *Evid Based Complement Alternat Med*. 2005 Sep;2(3):383-6.
45. El-Shitany NA, El-Haggar S, El-desoky K. Silymarin prevents adriamycin-induced cardiotoxicity and nephrotoxicity in rats. *Food Chem Toxicol*. 2008 Jul;46(7):2422-8.
46. Wenzel S, Stolte H, Soose M. Effects of silibinin and antioxidants on high glucose-induced alterations of fibronectin turnover in human mesangial cell cultures. *J Pharmacol Exp Ther*. 1996 Dec;279(3):1520-6.
47. Senturk H, Kabay S, Bayramoglu G, et al. Silymarin attenuates the renal ischemia/reperfusion injury-induced morphological

changes in the rat kidney. *World J Urol.* 2008 Aug;26(4):401-7.

48. Turgut F, Bayrak O, Catal F, et al. Antioxidant and protective effects of silymarin on ischemia and reperfusion injury in the kidney tissues of rats. *Int Urol Nephrol.* 2008;40(2):453-60.

49. Caimi G, Carollo C, Lo Presti R. Chronic renal failure: oxidative stress, endothelial dysfunction and wine. *Clin Nephrol.* 2004 Nov;62(5):331-5.

50. Bertelli AA, Migliori M, Panichi V, et al. Resveratrol, a component of wine and grapes, in the prevention of kidney disease. *Ann N Y Acad Sci.* 2002 May;957:230-8.

51. Giovannini L, Migliori M, Longoni BM, et al. Resveratrol, a polyphenol found in wine, reduces ischemia reperfusion injury in rat kidneys. *J Cardiovasc Pharmacol.* 2001 Mar;37(3):262-70.

52. Saito M, Satoh S, Kojima N, et al. Effects of a phenolic compound, resveratrol, on the renal function and costimulatory adhesion molecule CD86 expression in rat kidneys with ischemia/reperfusion injury. *Arch Histol Cytol.* 2005;68(1):41-9.

53. Chander V, Chopra K. Protective effect of resveratrol, a polyphenolic phytoalexin on glycerol-induced acute renal failure in rat kidney. *Ren Fail.* 2006;28(2):161-9.

54. Chander V, Chopra K. Protective effect of nitric oxide pathway in resveratrol renal ischemia-reperfusion injury in rats. *Arch Med Res.* Jan 2006;37(1):19-26.

55. Chander V, Chopra K. Role of nitric oxide in resveratrol-induced renal protective effects of ischemic preconditioning. *J Vasc Surg.* 2005 Dec;42(6):1198-205.

56. Chander V, Tirkey N, Chopra K. Resveratrol, a polyphenolic phytoalexin protects against cyclosporine-induced nephrotoxicity through nitric oxide dependent mechanism. *Toxicology.* 2005 May 15;210(1):55-64.

57. Kolgazi M, Sener G, Cetinel S, Gedik N, Alican I. Resveratrol reduces renal and lung injury caused by sepsis in rats. *J Surg Res.* 2006 Aug;134(2):315-21.

58. Silan C, Uzun O, Comunoglu NU, Gokcen S, Bedirhan S, Cengiz M. Gentamicin-induced nephrotoxicity in rats ameliorated and healing effects of resveratrol. *Biol Pharm Bull.* 2007 Jan;30(1):79-83.

59. Do Amaral CL, Francescato HD, Coimbra TM, et al. Resveratrol attenuates cisplatin-induced nephrotoxicity in rats. *Arch Toxicol.* 2008 Jun;82(6):363-70.

60. Sharma S, Anjaneyulu M, Kulkarni SK, Chopra K. Resveratrol, a polyphenolic phytoalexin, attenuates diabetic nephropathy in rats. *Pharmacology.* 2006;76(2):69-75.

61. Whaley-Connell AT, Sowers JR, McFarlane SI, et al. Diabetes mellitus in CKD: Kidney Early Evaluation Program (KEEP) and National Health and Nutrition and Examination Survey (NHANES) 1999-2004. *Am J Kidney Dis.* 2008 Apr;51(4 Suppl 2):S21-9.

62. Fox CS, Muntner P. Trends in diabetes, high cholesterol, and hypertension in chronic kidney disease among U.S. adults: 1988-1994 to 1999-2004. *Diabetes Care.* 2008 Jul;31(7):1337-42.

63. Orasanu G, Plutzky J. The pathologic continuum of diabetic vascular disease. *J Am Coll Cardiol.* 2009 Feb 3;53(5 Suppl):S35-42.

64. Bohlender JM, Franke S, Stein G, Wolf G. Advanced glycation end products and the kidney. *Am J Physiol Renal Physiol.* 2005 Oct;289(4):F645-59.

65. Uribarri J, Cai W, Sandu O, Peppia M, Goldberg T, Vlassara H. Diet-derived advanced glycation end products are major contributors to the body's AGE pool and induce inflammation in healthy subjects. *Ann N Y Acad Sci.* 2005 Jun;1043:461-6.

66. Linden E, Cai W, He JC, et al. Endothelial dysfunction in patients with chronic kidney disease results from advanced glycation end products (AGE)-mediated inhibition of endothelial nitric oxide synthase through RAGE activation. *Clin J Am Soc Nephrol.* 2008 May;3(3):691-8.

67. de Vinuesa SG, Goicoechea M, Kanter J, et al. Insulin resistance, inflammatory biomarkers, and adipokines in patients with chronic kidney disease: effects of angiotensin II blockade. *J Am Soc Nephrol*. 2006 Dec;17(12 Suppl 3):S206-12.
68. Johnson DW, Armstrong K, Campbell SB, et al. Metabolic syndrome in severe chronic kidney disease: Prevalence, predictors, prognostic significance and effects of risk factor modification. *Nephrology (Carlton)*. 2007 Aug;12(4):391-8.
69. Lucove J, Vupputuri S, Heiss G, North K, Russell M. Metabolic syndrome and the development of CKD in American Indians: the Strong Heart Study. *Am J Kidney Dis*. 2008 Jan;51(1):21-8.
70. Uribarri J, Tuttle KR. Advanced glycation end products and nephrotoxicity of high-protein diets. *Clin J Am Soc Nephrol*. 2006 Nov;1(6):1293-9.
71. Gault MH, Barrett BJ. Analgesic nephropathy. *Am J Kidney Dis*. 1998 Sep;32(3):351-60.
72. Elseviers MM, De Broe ME. Analgesic nephropathy: is it caused by multi-analgesic abuse or single substance use? *Drug Saf*. 1999 Jan;20(1):15-24.
73. Mann JF, Goerig M, Brune K, Luft FC. Ibuprofen as an over-the-counter drug: is there a risk for renal injury? *Clin Nephrol*. 1993 Jan;39(1):1-6.
74. Naughton CA. Drug-induced nephrotoxicity. *Am Fam Physician*. 2008 Sep 15;78(6):743-50.
75. Zager RA. Pathogenetic mechanisms in nephrotoxic acute renal failure. *Semin Nephrol*. 1997 Jan;17(1):3-14.
76. Amudha G, Josephine A, Varalakshmi P. Role of lipoic acid in reducing the oxidative stress induced by cyclosporine A. *Clin Chim Acta*. Oct 2006;372(1-2):134-9.
77. Takaoka M, Ohkita M, Kobayashi Y, Yuba M, Matsumura Y. Protective effect of alpha-lipoic acid against ischaemic acute renal failure in rats. *Clin Exp Pharmacol Physiol*. 2002 Mar;29(3):189-94.
78. Sehirlı O, Sener E, Cetinel S, Yuksel M, Gedik N, Sener G. Alpha-lipoic acid protects against renal ischaemia-reperfusion injury in rats. *Clin Exp Pharmacol Physiol*. 2008 Mar ;35(3):249-55.
79. Malarkodi KP, Balachandar AV, Varalakshmi P. Protective effect of lipoic acid on adriamycin induced lipid peroxidation in rat kidney. *Mol Cell Biochem*. 2003 May;247(1-2):9-13.
80. Malarkodi KP, Balachandar AV, Varalakshmi P. The influence of lipoic acid on adriamycin-induced hyperlipidemic nephrotoxicity in rats. *Mol Cell Biochem*. 2003 May;247(1-2):139-45.
81. Amudha G, Josephine A, Mythili Y, Sundarapandiyan R, Varalakshmi P. Therapeutic efficacy of DL-alpha-lipoic acid on cyclosporine A induced renal alterations. *Eur J Pharmacol*. 2007 Oct 1;571(2-3):209-14.
82. Amudha G, Josephine A, Varalakshmi P. Beneficial effect of DL-alpha-lipoic acid on cyclosporine A induced hyperlipidemic nephropathy in rats. *Mol Cell Biochem*. 2007 Jul;301(1-2):165-71.
83. Abdel-Zaher AO, Abdel-Hady RH, Mahmoud MM, Farrag MM. The potential protective role of alpha-lipoic acid against acetaminophen-induced hepatic and renal damage. *Toxicology*. 2008 Jan 20;243(3):261-70.
84. Bhatti F, Mankhey RW, Asico L, Quinn MT, Welch WJ, Maric C. Mechanisms of antioxidant and pro-oxidant effects of alpha-lipoic acid in the diabetic and nondiabetic kidney. *Kidney Int*. 2005 Apr;67(4):1371-80.
85. Chang JW, Lee EK, Kim TH, et al. Effects of alpha-lipoic acid on the plasma levels of asymmetric dimethylarginine in diabetic end-stage renal disease patients on hemodialysis: a pilot study. *Am J Nephrol*. 2007;27(1):70-4.
86. Kandler BS. Carnitine: an overview of its role in preventive medicine. *Prev Med*. 1986 Jul;15(4):373-90.
87. Matera M, Bellinghieri G, Costantino G, Santoro D, Calvani M, Savica V. History of L-carnitine: implications for renal disease. *J Ren Nutr*. 2003 Jan;13(1):2-14.

88. Calo LA, Bertipaglia L, Pagnin E. Antioxidants, carnitine and erythropoietin. *G Ital Nefrol.* 2006 Jan-Feb;23 Suppl 34:S47-50.
89. Schreiber BD. Debate forum: levocarnitine therapy is rational and justified in selected dialysis patients. *Blood Purif.* 2006;24(1):128-39.
90. Sloan RS, Kastan B, Rice SI, et al. Quality of life during and between hemodialysis treatments: role of L-carnitine supplementation. *Am J Kidney Dis.* 1998 Aug;32(2):265-72.
91. Brass EP, Adler S, Sietsema KE, et al. Intravenous L-carnitine increases plasma carnitine, reduces fatigue, and may preserve exercise capacity in hemodialysis patients. *Am J Kidney Dis.* 2001 May;37(5):1018-28.
92. Golper TA, Goral S, Becker BN, Langman CB. L-carnitine treatment of anemia. *Am J Kidney Dis.* 2003 Apr;41(4 Suppl 4):S27-34.
93. Savica V, Santoro D, Mazzaglia G, et al. L-carnitine infusions may suppress serum C-reactive protein and improve nutritional status in maintenance hemodialysis patients. *J Ren Nutr.* 2005 Apr;15(2):225-30.
94. Alvares Delfino VD, de Andrade Vianna AC, Mocelin AJ, Barbosa DS, Mise RA, Matsuo T. Folic acid therapy reduces plasma homocysteine levels and improves plasma antioxidant capacity in hemodialysis patients. *Nutrition.* 2007 Mar;23(3):242-7.
95. Bostom AG, Carpenter MA, Kusek JW, et al. Rationale and design of the Folic Acid for Vascular Outcome Reduction In Transplantation (FAVORIT) trial. *Am Heart J.* 2006 Sep;152(3):448. e1-7.
96. Menon V, Wang X, Greene T, et al. Homocysteine in chronic kidney disease: Effect of low protein diet and repletion with B vitamins. *Kidney Int.* 2005 Apr;67(4):1539-46.
97. Nanayakkara PW, van Guldener C, ter Wee PM, et al. Effect of a treatment strategy consisting of pravastatin, vitamin E, and homocysteine lowering on carotid intima-media thickness, endothelial function, and renal function in patients with mild to moderate chronic kidney disease: results from the Anti-Oxidant Therapy in Chronic Renal Insufficiency (ATIC) Study. *Arch Intern Med.* 2007 Jun 25;167(12):1262-70.
98. Farmer A, Montori V, Dinneen S, Clar C. Fish oil in people with type 2 diabetes mellitus. *Cochrane Database Syst Rev.* 2001 (3):CD003205.
99. Hartweg J, Farmer AJ, Holman RR, Neil A. Potential impact of omega-3 treatment on cardiovascular disease in type 2 diabetes. *Curr Opin Lipidol.* 2009 Feb;20(1):30-8.
100. Moreira AC, Gaspar A, Serra MA, Simoes J, Lopes da Cruz J, Amaral TF. Effect of a sardine supplement on C-reactive protein in patients receiving hemodialysis. *J Ren Nutr.* 2007 May;17(3):205-13.
101. Miller ER 3rd, Juraschek SP, Appel LJ, et al. The effect of n-3 long-chain polyunsaturated fatty acid supplementation on urine protein excretion and kidney function: meta-analysis of clinical trials. *Am J Clin Nutr.* 2009 Jun;89(6):1937-45.
102. Parinyasiri U, Ong-Ajyooth L, Parichatikanond P, Ong-Ajyooth S, Liammongkolkul S, Kanyog S. Effect of fish oil on oxidative stress, lipid profile and renal function in IgA nephropathy. *J Med Assoc Thai.* 2004 Feb;87(2):143-9.
103. Bell S, Cooney J, Packard CJ, Caslake M, Deighan CJ. Omega-3 fatty acids improve postprandial lipaemia in patients with nephrotic range proteinuria. *Atherosclerosis.* 2009 Jul;205(1):296-301.
104. Garman JH, Mulrone S, Manigrasso M, Flynn E, Maric C. Omega-3 fatty acid rich diet prevents diabetic renal disease. *Am J Physiol Renal Physiol.* 2009 Feb;296(2):F306-16.
105. Abdel-Naim AB, Abdel-Wahab MH, Attia FF. Protective effects of vitamin e and probucol against gentamicin-induced nephrotoxicity in rats. *Pharmacol Res.* 1999 Aug;40(2):183-7.
106. Boaz M, Smetana S, Weinstein T, et al. Secondary prevention with antioxidants of cardiovascular disease in endstage renal disease (SPACE): randomised placebo-controlled trial. *Lancet.* 2000 Oct 7;356(9237):1213-18.
107. Khajehdehi P, Mojerlou M, Behzadi S, Rais-Jalali GA. A randomized, double-blind, placebo-controlled trial of supplementary vitamins E, C and their combination for treatment of haemodialysis cramps. *Nephrol Dial Transplant.* 2001 Jul;16(7):1448-51.

108. Mune M, Yukawa S, Kishino M, et al. Effect of vitamin E on lipid metabolism and atherosclerosis in ESRD patients. *Kidney Int Suppl.* 1999 Jul;71:S126-9.
109. Ramos R, Gomez-Gerique N, Martinez-Castelao A. Lipoprotein oxidation profile in end stage renal disease patients. Role of vitamin C supplementation. *Nefrologia.* 2005;25(2):178-84.
110. Tain YL, Freshour G, Dikalova A, Griendling K, Baylis C. Vitamin E reduces glomerulosclerosis, restores renal neuronal NOS, and suppresses oxidative stress in the 5/6 nephrectomized rat. *Am J Physiol Renal Physiol.* 2007 May;292(5):F1404-10.

All Contents Copyright © 1995-2010 Life Extension Foundation All rights reserved.

**LifeExtension®**

These statements have not been evaluated by the FDA. These products are not intended to diagnose, treat, cure or prevent any disease. The information provided on this site is for informational purposes only and is not intended as a substitute for advice from your physician or other health care professional or any information contained on or in any product label or packaging. You should not use the information on this site for diagnosis or treatment of any health problem or for prescription of any medication or other treatment. You should consult with a healthcare professional before starting any diet, exercise or supplementation program, before taking any medication, or if you have or suspect you might have a health problem. You should not stop taking any medication without first consulting your physician.

Copyright of Life Extension is the property of Life Extension Foundation and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.