

# Ketogenic Diet and Deuterium Depleted Water for the Prevention and Treatment of Cancer and Neurodegenerative Conditions

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The central importance of the TCA cycle in many biochemical pathways makes it a critical target for controlling cellular metabolism to prevent disease (1). Metabolic water production in connection with mitochondrial matrix complex-IV function offers a novel mechanism to control deuterium content of cells via ketogenic substrate oxidation known to carry less deuterium from oils and fat. It is proposed that metabolic water production in the mitochondrial matrix, upon ketogenic substrate oxidation, preserves health via low deuterium substrate shuttling from the TCA cycle for gluconeogenesis. For example, metabolic water controls the deuterium content of the nucleotide sugar deoxyribose, from fatty acid chain shortening and redistribution of low-deuterium acetyl-CoA. These reactions involving hydrogen bonds control deuterium related oncoisotopic effects, which might be exploited in anti-cancer, anti-aging and anti-degenerative therapies and prevention. Consistent with the above, the effect of low deuterium (<sup>2</sup>H) in water has been shown to control cell proliferation in numerous biological systems *in vitro* and *in vivo*, as well as in human studies (2-11). The clinical effectiveness of deuterium depleted water (DDW) is discussed herein. Complete or partial tumor regression has been established in mice xenografts with MDA-MB-231, MCF-7 human breast adenocarcinoma cells, and PC-3 human prostate tumor cells and. The anti-cancer effect of <sup>2</sup>H-depletion has already been confirmed in a double-blind, randomized, 4-month-long, phase II clinical trial on prostate cancer, and the extended follow up suggests that <sup>2</sup>H-depletion delays disease progression. DDW is a promising new integrative treatment modality in cancer and its prevention by lowering extra-mitochondrial deuterium loading into cellular DNA. Deuterium-depletion, in addition to conventional treatments, improves mean survival in lung cancer even in an advanced disease, complicated by distant brain metastases. In breast cancer patients DDW treatment, in combination with, or as an extension of, conventional therapies, significantly improved survival in advanced disease and was also effective in the prevention of recurrences in early stage breast cancer.



## References:

- 1) Boros, L. G. (2016). Submolecular regulation of cell transformation by deuterium depleting water exchange reactions in the tricarboxylic acid substrate cycle. *Med Hypotheses*, 87, 69-74. - DOI 10.1016/j.mehy.2015.11.016
- 2) Somlyai, G. et al. (1993). Naturally occurring deuterium is essential for the normal growth rate of cells. *FEBS Lett*, 317, 1-4.
- 3) Somlyai, G. et al. (1998). Naturally occurring deuterium may have a central role in cell signaling. J.R. Heys, D.G. Melillo (Eds.), In: *Synthesis and applications of isotopically labelled compounds*, John Wiley and Sons Ltd, New York, pp. 137-141.
- 4) Somlyai, G. et al. (1998). The biological effects of deuterium-depleted water, a possible new tool in cancer therapy. *J Oncol*, 30, 91-94.
- 5) Gyöngyi, G. (2000). Deuterium depletion can decrease the expression of c-myc, Ha-ras and p53 gene in carcinogen-treated mice. *In Vivo*, 14 (2000), pp. 437-439.
- 6) Cong, F. S. et al. (2010). Deuterium-depleted water inhibits human lung carcinoma cell growth by apoptosis. *Exp Ther Med*, 1, 277-283.
- 7) Boros, L. G. et al. (2014). Fumarate hydratase and deuterium depletion control oncogenesis via NADPH-dependent reductive synthesis: mitochondrial matrix water, DNA deuteration and epigenetic events. *Cancer Res*, 74 (19 Suppl.) Abstract nr 1426. doi: 10.1158/1538-7445.AM2014-1426
- 8) Kovács, A. et al. (2011). Deuterium depletion may delay the progression of prostate cancer. *J Cancer Ther*, 2, 548-556. <http://dx.doi.org/10.4236/jct.2011.24075>
- 9) Gyöngyi, Z. et al. (2013). Deuterium-depleted water effects on survival of lung cancer patients and expression of Kras and Bcl2 genes in mouse lung. *Nutr Cancer*, 65, 240-246. <http://dx.doi.org/10.1080/01635581.2013.756533>
- 10) Krempels, K. et al. (2008). A retrospective evaluation of the effects of deuterium-depleted water consumption on four patients with brain metastases from lung cancer. *Integr Cancer Ther*, 7, 172-181. <http://dx.doi.org/10.1177/1534735408322851>
- 11) Hao, D., et al. (2016). Temporal characterization of serum metabolite signatures in lung cancer patients undergoing treatment. *Metabolomics*, 12, 58. - DOI 10.1007/s11306-016-0961-5