

USANA Technical Bulletin

Disclaimer: The information provided in this Technical Bulletin is strictly educational. It may not be used to promote USANA products, nor is it intended as medical advice. For diagnosis and treatment of medical disorders, consult your health care professional. When there are references to third party websites, addresses, and/or phone numbers, USANA, Inc. makes no claim, actual or implied, regarding the content or validity of the information obtained from such sources. This Technical Bulletin may be copied and freely distributed only if all text remains intact and unchanged.

Glutathione and N-Acetyl-L-Cysteine: The Glutathione Complex

Technical Background

- The glutathione complex is comprised of two nutrient compounds: glutathione and N-acetyl L-cysteine. Glutathione is an important antioxidant, and N-acetyl L-cysteine is an essential precursor for glutathione.
- Glutathione plays a central role in the glutathione redox cycle, a system important in neutralizing free radicals and providing protection from free hydroperoxides and lipid peroxides.¹
- Glutathione is an important antioxidant because it is extremely abundant in the body and already resides within every cell, allowing it to scavenge free radicals both inside and outside the cell. Its extracellular activity protects lung, kidney, liver, and intestinal tissues from exogenous free radicals and toxins.²
- Studies show that glutathione is also important as an antioxidant through its ability to regenerate and prolong the activity of vitamin E.³
- Research indicates that glutathione and N-acetyl L-cysteine supplementation may be effective in treating a number of conditions, including oxidative injury to the lung from pollutants,⁴ oxidative injury to the skin from ultraviolet radiation, injury to the heart and lung from antitumor therapy, and injury to the kidney and small intestine from reperfusion following ischemic events.⁵
- Patients with HIV, cancer, and other serious diseases tend to have lower levels of glutathione than normal, making them especially good candidates for supplementation. Research shows that N-acetyl L-cysteine can enhance human T-cell function and survival,⁶ protect neuronal cells, and slow disease progression and dementia among HIV patients.⁷ It has been further used as a chemopreventative and tumor-fighting agent in cancer research.^{8,9} It also has been shown to inhibit hepatitis B replication.¹⁰
- Glutathione deficiencies can be reversed through supply of additional cysteine in the diet and through supplementation. The most effective supplemental form is N-acetyl L-cysteine.

Sources and Recommended Intake

- No Recommended Dietary Allowances (RDAs) have been established for glutathione and N-acetyl L-cysteine.

- The best food sources of glutathione include fruits, vegetables, and meats.¹¹ Because N-acetyl L-cysteine is cell-permeable, it is the most effective form of glutathione supplementation.

Abstracts

Goldman Y, Peled A, Shinitzky M. Effective elimination of lung metastases induced by tumor cells treated with hydrostatic pressure and N-acetyl-L-cysteine. *Cancer Res.* 2000 Jan 15;60(2):350-8. In previous studies, we have demonstrated that application of high hydrostatic pressure (P) to tumor cells in the presence of a slow-reacting membrane-impermeable cross-linker (CL), 2'-3'-adenosine dialdehyde, can rearrange cell surface proteins into immunogenic clusters. Here, we present evidence indicating that subsequent reduction of surface protein disulfides with N-acetyl-L-cysteine (NAC) further augments the immunogenic potential of PCL-modified tumor cells both in vitro and in vivo. Immunotherapy with PCL+NAC-modified 3LL-D122 Lewis lung carcinoma cells plus i.v. delivery of NAC in mice bearing established lung metastases provoked an antitumor response capable of eradicating the metastatic nodules as demonstrated by restoration of normal lung weight and histology. In addition, immunization with PCL+NAC-modified tumor cells gave rise to a strong delayed-type hypersensitivity recall response against parental D122 cells. We propose that this novel two-prong strategy, based on local immunization with autologous PCL+NAC-modified tumor cells and systemic boosting with NAC, could provide a practical, effective immunotherapeutic regimen for the treatment of human cancer.

References

- ¹ Rivlin RS. Riboflavin. Pp. 167-173. In. EE Ziegler and LJ Filer (eds.) Present Knowledge in Nutrition. ILSI Press, Washington, DC.
- ² Lavender OA and RF Burk. Selenium. Pp. 320-328. In. EE Ziegler and LJ Filer (eds.) Present Knowledge in Nutrition. ILSI Press, Washington, DC.
- ³ Chan AC. Partners in defense, vitamin E and vitamin C. *Can J Physiol Pharmacol* 1993 Sep;71(9):725-31.
- ⁴ Rahman Q, Abidi P, Afaq F, Schiffmann D, Mossman BT, Kamp DW, Athar M. Glutathione redox system in oxidative lung injury. *Crit Rev Toxicol.* 1999 Nov;29(6):543-68.
- ⁵ Aw TY, Wierzbicka G, Jones DP. Oral glutathione increases tissue glutathione in vivo. *Chem Biol Interact* 1991;80:89-97.
- ⁶ Cayota A, Vuillier F, Gonzalez G, Dighiero G. In vitro antioxidant treatment recovers proliferative responses of anergic CD4+ lymphocytes from human immunodeficiency virus-infected individuals. *Blood* 1996 Jun 1; 87(11):4746-53.
- ⁷ Sung JH, Shin SA, Park HK, Montelaro RC, Chong YH. Protective effect of glutathione in HIV-1 lytic peptide 1-induced cell death in human neuronal cells. *J Neurovirol.* 2001 Oct;7(5):454-65.
- ⁸ Ho YS; Lee HM; Mou TC; Wang YJ; Lin JK . Suppression of nitric oxide-induced apoptosis by N-acetyl-L-cysteine through modulation of glutathione, bcl-2, and bax protein levels. *Mol Carcinog* 1997 Jun; 19(2):101-13.
- ⁹ Goldman Y, Peled A, Shinitzky M. Effective elimination of lung metastases induced by tumor cells treated with hydrostatic pressure and N-acetyl-L-cysteine. *Cancer Res.* 2000 Jan 15;60(2):350-8.
- ¹⁰ Weiss L, Hildt E, Hofschneider PH. Anti-hepatitis B virus activity of N-acetyl-L-cysteine (NAC): new aspects of a well-established drug. *Antiviral Res* 1996 Aug;32(1):43-53.
- ¹¹ Jones DP, Coates RJ, Flagg EW, Eley JW, Block G, Greenberg RS, et al. Glutathione in foods listed in the National Cancer Institute's health habits and history food frequency questionnaire. *Nutr Cancer* 1992;17:57-75.