Glutathione Content in Foods and Dietary Sources of Glutathione

DIETARY SOURCES OF GLUTATHIONE: Glutathione (GSH) is an antioxidant and detoxifying agent whose protective role has been demonstrated in numerous clinical studies. GSH is synthesized rapidly in the liver, kidneys, and other tissues of the body, including the gastrointestinal tract. This process is effected by aging and disease, as both of these conditions result in reduced tissue and blood levels of glutathione. Dietary forms of glutathione are efficiently absorbed into the blood, however the same is not true for glutathione supplements in humans. When healthy subjects were given a single dose of up to 3,000 mg of glutathione researchers found there was no increase in blood glutathione levels. (*Witschi A, Reddy S, Stofer B, Lauterburg BH. The systemic availability of oral glutathione. Eur J Clin Pharmacol 1992;43(6):667-9.*) The authors of this study concluded "it is not feasible to increase circulating glutathione to a clinically beneficial extent by the oral administrating of a single dose of 3 g of glutathione." Johnson and coworkers (*Johnston CJ, Meyer CG, Srilakshmi JC. Vitamin C elevates red blood cell glutathione in healthy adults. Am J Clin Nutr 58:103-5, 1993*) found that blood glutathione levels rose nearly 50% in healthy individuals taking 500 mg of vitamin C daily. Vitamin C facilitates an increase in blood glutathione levels by supplying the body with a nutrient that is critical to the manufacture of it. In addition, to vitamin C, dietary sources of glutathione and several other nutritional compounds can help increase glutathione levels including N-acetylcysteine (NAC), alpha-lipoic acid, glutamine, methionine, and undenatured whey protein (*Bounous, G., and Gold, P., The biological activity of undenatured dietary whey proteins [Immunocal]: role of glutathione, Clin. Invest. Med. (1991) 14(4):296-309.*). N-acetylcysteine has been used in combination with glutamic acid (or glutamine) and glycine (*Clark, J. at www.cfsn.com*) and in addition, NAC has been studied in combination with dietary proteins (*Quig, D., Cysteine metabolism and metal toxicity, Alternative Medicine Review (1998) 3(4):262-270.*).

HERBS: The herb milk-thistle, an excellent source of the antioxidant compound silymarin may help to prevent glutathione depletion in the liver. Silymarin is many times more potent in antioxidant activity than the better known antioxidant vitamins E and vitamin C. The protective effect of silymarin against liver damage has been demonstrated in a number of scientific studies. Silymarin has been shown to protect against liver damage by extremely toxic chemicals (this toxicity is mediated by their ability to produce dangerous and destructive unstable compounds called free radicals) including amanita toxin, carbon tetrachloride, galactosamine, and praseodymium nitrate. Silymarin enhances detoxification in the liver by preventing the depletion of glutathione. Glutathione in the liver is essential to the liver's ability to detoxify. The higher the liver glutathione content, the greater the liver's capacity to detoxify harmful chemicals. Chemicals which can damage the liver, (including alcohol and acetominophen), cause the concentration of glutathione in the liver is substantially reduced, making the hepatocytes (liver cells) susceptible to damage. Silymarin not only prevents the depletion of glutathione induced by alcohol and other toxins (*Chrungoo VJ et al. Indian J Exp Biol. 1997 Jun;35(6):611-7.*), but can increase the level of glutathione in the cells of the liver (hepatocytes) (*Valenzuela A et al. Planta Med. 1989 Oct;55(5):420-2.*), and possibly by up to 35%.

Curcumin may also be useful as an agent to increase tissue glutathione levels (*Dickinson, D.A., Iles, K.E., Zhang, H., Blank, V., and Forman, H.J., Curcumin alters EpRE and AP-1 binding complexes and elevates glutamate-cysteine ligase gene expression, FASEB J. (2003) 17(3):473-475.*)

Alpha Lipoic Acid has also demonstrated it's ability to increase glutathione levels and act as a potent antioxidant in numerous scientific studies.

VITAMINS & MINERALS: vitamin B6, riboflavin, and selenium are required in the manufacture of glutathione, and adequate dietary consumption of foods rich in (or supplementation with) these vitamins and minerals can help the body to optimize glutathione production.

MILK PRODUCTS & MEAT: Dietary glutathione occurs in highest amounts in fresh (uncooked) meats, in moderate amounts in certain raw fruits and vegetables, and is absent or found only in small amounts in grains and pasteurized dairy products (*JONES DP, COATES RJ, FLAGG EW, et al. (1992) Glutathione in Foods listed in the National Cancer Institute's Health Habits and History Food Frequency Questionnaire. Nutr Cancer 17: 57-75*). Foods richest in sulfur-containing amino acids are usually the best source of glutathione.

Although undenatured whey protein is one of the best precursors (building blocks) for glutathione, it contains only moderate levels of naturally occuring glutathione. Freshly prepared (rare or raw) meats, raw (unpasturized) milk, and raw eggs are also an especially rich source of glutathione. Cooking reduces glutathione content, and storage also impacts the glutathione content of foods. In human breast milk put aside for later use by breast-fed babies, a 73-79% loss of glutathione occurred when the milk was either kept at room temperature or refrigerated for two hours. (*Ankrah NA, Appiah-Opong R, Dzokoto C. Human breastmilk storage and the glutathione content. J Trop Pediatr. 2000;46(2):111-3.*)

FRUITS & VEGETABLES: Fresh fruits and vegetables provide excellent levels of glutathione, but cooked foods contained far less or none at all, and highly processed foods contain less than minimally processed cooked foods. Glutathione assays of fruits and vegetables may yield contrasting results because glutathione levels vary both diurnally (*KOIKE S, PATTERSON BD (1988) Diurnal variation of glutathione levels in tomato seedlings. Hort Sci 23: 713-714; SCHUPP R, RENNENBERG H (1988) Diurnal changes in the glutathione content of spruce needles (Picea abies L.) Plant Sci 57: 113-117*) with the stage of development of the plant (*EARNSHAW BA, JOHNSON MA (1987) Control of wild carrot somatic embryo development by antioxidants. Plant Physiol 85: 273-276;*), and due to various environmental factors (*DE KOK LJ, DE KAN PJL, TANCZOS OG, KUIPER PJC (1981) Sulphate-induced accumulation of glutathione and frost-tolerance of spinach leaf tissue. Physiol Plant 53: 435-438; WISE RR, NAYLOR AW (1987) Chilling-enhanced photooxidation. The peroxidative destruction of lipids during chilling injury to photosynthesis and ultrastructure. Plant Physiol 83: 272-277*). Asparagus contains more glutathione than all other fruits and vegetables analyzed to date. (*Jones, D.P. and others: Glutathione in foods listed in the National Cancer Institute's health habits and history food frequency questionnaire, Nutrition and Cancer 17 (1), p. 57, 1992.*) In a study which compared the overall antioxidant activity of potatoes, bell peppers, carrots, onions and broccoli, potatoes ranked second highest after broccoli.

Per serving, asparagus, avocadoes, asparagus, squash, okra, cauliflower, broccoli, potatoes, spinach, walnuts, garlic, and raw tomatoes have the highest glutathione content compared to other vegetables and are particularly rich dietary sources of glutathione (please see the Table 1. below).

Table 1. Comparison of Glutathione in Fresh vs. Cooked Foods (in milligrams per 3 1/2 oz (100 g) serving)

Food	Glutathione Content	
Apples	Uncooked: 21.0 mg	Cooked: 0.0 mg
Carrots	Uncooked: 74.6 mg	Cooked: 0.0 mg
Grapefruit	Uncooked: 70.6 mg	Cooked: 0.0 mg
Spinach	Uncooked: 166 mg	Cooked: 27.1 mg
Spinach (4)	Uncooked: 9.65 mg	Cooked: N/A mg
Tomatoes	Uncooked: 169 mg	Cooked: 0.0 mg
Asparagus (4)	Uncooked: 28.3 mg	Cooked: N/A mg
Avocado (4)	Uncooked: 27.7 mg	Cooked: N/A mg
Purslane (4)	Uncooked: 14.81 mg	Cooked: N/A mg

References :

(1). JONES DP, COATES RJ, FLAGG EW, et al. (1992) Glutathione in Foods listed in the National Cancer Institute's Health Habits and History Food Frequency Questionnaire. Nutr Cancer 17: 57-75

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(3). BLOCK G, DRESSER CM, HARTMAN AM, CARROLL MD (1985) Nutrient sources in the American diet: Quantitative data from the NHANES II Survey. Macronutrients and Fats. Am J Epidemiol 122: 27-40

(4) SIMOPOULOS AP, NORMAN HA, GILLASPY JE (1995) Purslane in human nutrition and its potential for world agriculture. World Rev Nutr Diet 77: 47-74

References website: http://www.nutritionadvisor.com/glutathione_foods.php