

Chemoprotective glucosinolates and isothiocyanates of broccoli sprouts: metabolism and excretion in humans.

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Abstract

Broccoli sprouts are a rich source of glucosinolates and isothiocyanates that induce phase 2 detoxication enzymes, boost antioxidant status, and protect animals against chemically induced cancer. Glucosinolates are hydrolyzed by myrosinase (an enzyme found in plants and bowel microflora) to form isothiocyanates. In vivo, isothiocyanates are conjugated with glutathione and then sequentially metabolized to mercapturic acids. These metabolites are collectively designated dithiocarbamates. We studied the disposition of broccoli sprout glucosinolates and isothiocyanates in healthy volunteers. Broccoli sprouts were grown, processed, and analyzed for (a) inducer potency; (b) glucosinolate and isothiocyanate concentrations; (c) glucosinolate profiles; and (d) myrosinase activity. Dosing preparations included uncooked fresh sprouts (with active myrosinase) as well as homogenates of boiled sprouts that were devoid of myrosinase activity and contained either glucosinolates only or isothiocyanates only. In a crossover study, urinary dithiocarbamate excretion increased sharply after administration of broccoli sprout glucosinolates or isothiocyanates. Cumulative excretion of dithiocarbamates following 111-micromol doses of isothiocyanates was greater than that after glucosinolates (88.9 +/- 5.5 and 13.1 +/- 1.9 micromol, respectively; $P < 0.0003$). In subjects fed four repeated 50-micromol doses of isothiocyanates, the intra- and intersubject variation in dithiocarbamate excretion was very small (coefficient of variation, 9%), and after escalating doses, excretion was linear over a 25- to 200-micromol dose range. Dithiocarbamate excretion was higher when intact sprouts were chewed thoroughly rather than swallowed whole (42.4 +/- 7.5 and 28.8 +/- 2.6 micromol; $P = 0.049$). These studies indicate that isothiocyanates are about six times more bioavailable than glucosinolates, which must first be hydrolyzed. Thorough chewing of fresh sprouts exposes the glucosinolates to plant myrosinase and significantly increases dithiocarbamate excretion. These findings will assist in the design of dosing regimens for clinical studies of broccoli sprout efficacy.

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