Misconception 4—Human exposures to potential cancer hazards are primarily to synthetic chemicals

Contrary to common perception, 99.9% of the chemicals humans ingest are natural. The amounts of synthetic pesticide residues in plant foods, for example, are extremely low compared to the amounts of natural "pesticides" produced by plants themselves (Ames & al. 1990a; Ames & al. 1990b; Gold & al. 1999; Gold & al. 1997b; Gold & Zeiger 1997). Of all dietary pesticides that humans eat, 99.99% are natural: these are chemicals produced by plants to defend themselves against fungi, insects, and other animal predators (Ames & al. 1990a; Ames & al. 1990b). Each plant produces a different array of such chemicals. On average, the Western diet includes roughly 5,000 to 10,000 different natural pesticides and their break-down products. Americans eat about 1,500 mg of natural pesticides per person per day, which is about 10,000 times more than they consume of synthetic pesticide residues (Ames & al. 1990b). Even though only a small proportion of natural pesticides has been tested for carcinogenicity, half of those tested (38/72) have been found to be carcinogenic in rodents; naturally occurring pesticides that are rodent carcinogens are ubiquitous in fruits, vegetables, herbs, and spices (Gold & al. 1997b; Gold & al. 1992) (table 2). Cooking of foods produces

burnt material—about 2,000 mg per person per day—that also contains many rodent carcinogens.

In contrast, the residues of 200 synthetic chemicals measured by United States Federal Drug Administration, including the synthetic pesticides thought to be of greatest importance, average only about 0.09 mg per person per day (Ames & al. 1990a; Gold & al. 1997b; Gold & al. 1992). In a single cup of coffee, the natural chemicals that are rodent carcinogens are about equal in weight to an entire year's worth of synthetic pesticide residues that are rodent carcinogens, even though only 3% of the natural chemicals in roasted coffee have been adequately tested for carcinogenicity (Gold & al. 1992) (table 3). This does not mean that coffee or natural pesticides are a cancer risk for humans,but rather that assumptions about high-dose animal cancer tests for assessing human risk at low doses need reexamination. No diet can be free of natural chemicals that are rodent carcinogens (Gold & al. 1999; Gold & al. 1997b; Gold & Zeiger 1997).

The emphasis in cancer bioassays of testing synthetic chemicals means that only minimal data are available on the enormous background of naturally occurring chemicals. If many of the natural chemicals were tested, it is likely that many dietary constituents would be carcinogens in high-dose animal tests. The importance for human cancer of any single rodent carcinogen in the diet is questionable because of the ubiquitous occurrence of so many naturally occurring chemicals that have not been tested and the fact that half of those tested are positive in such tests (**Misconception 6, p. 31**).

Table 2. Carcinogenicity status of natural pesticides tested in rodents[a]

Carcinogens: *N* = 38	acetaldehyde methylformylhydrazone, allyl isothiocyanate, arecoline.HCl, benzaldehyde, benzyl acetate, caffeic acid, capsaicin, catechol, clivorine, coumarin, crotonaldehyde, 3,4-dihydrocoumarin, estragole, ethyl acrylate, *N*2-γ-glutamyl-*p*-hydrazinobenzoic acid, hexanal methylformylhydrazine, *p*-hydrazinobenzoic acid.HCl, hydroquinone, 1-hydroxyanthraquinone, lasiocarpine, *d*-limonene, 3-methoxycatechol, 8-methoxypsoralen, *N*-methyl-*N*-formylhydrazine, α-methylbenzyl alcohol, 3-methylbutanal methylformylhydrazone, 4-methylcatechol, methyl eugenol, methylhydrazine, monocrotaline, pentanal methylformylhydrazone, petasitenine, quercetin, reserpine, safrole, senkirkine, sesamol, symphytine
Noncarcinogens: *N* = 34	atropine, benzyl alcohol, benzyl isothiocyanate, benzyl thiocyanate, biphenyl, *d*-carvone, codeine, deserpidine, disodium glycyrrhizinate, ephedrine sulphate, epigallocatechin, eucalyptol, eugenol, gallic acid, geranyl acetate, β-*N*-[γ-*l*(+)-glutamyl]-4-hydroxymethyl-phenylhydrazine, glycyrrhetinic acid, *p*-hydrazinobenzoic acid, isosafrole, kaempferol, *dl*-menthol, nicotine, norharman, phenethyl isothiocyanate, pilocarpine, piperidine, protocatechuic acid, rotenone, rutin sulfate, sodium benzoate, tannic acid, 1-trans-δ^9-tetrahydrocannabinol, turmeric oleoresin, vinblastine

The 38 rodent carcinogens listed at the top of the table occur in:

absinthe, allspice, anise, apple, apricot, banana, basil, beet, broccoli, Brussels sprouts, cabbage, cantaloupe, caraway, cardamom, carrot, cauliflower, celery, cherries, chili pepper, chocolate, cinnamon, citronella, cloves, coffee, collard greens, comfrey herb tea, corn, coriander, currants, dill, eggplant, endive, fennel, garlic, grapefruit, grapes, guava, honey, honeydew melon, horseradish, kale, lemon, lentils, lettuce, licorice, lime, mace, mango, marjoram, mint, mushrooms, mustard, nutmeg, onion, orange, oregano, paprika, parsley, parsnip, peach, pear, peas, black pepper, pineapple, plum, potato, radish, raspberries, rhubarb, rosemary, rutabaga, sage, savory, sesame seeds, soybean, star anise, tarragon, tea, thyme, tomato, turmeric, and turnip.

Source: ***Carcinogenic Potency Database*** (http://potency.berkeley.edu; Gold & al. 1999; Gold & Zeiger 1997).
Note: Fungal toxins are not included.

Table 3: Carcinogenicity in rodents of natural chemicals in roasted coffee

Carcinogens: N = 21	acetaldehyde, benzaldehyde, benzene, benzofuran, benzo(*a*)pyrene, caffeic acid, catechol, 1,2,5,6-dibenzanthracene, ethanol, ethylbenzene, formaldehyde, furan, furfural, hydrogen peroxide, hydroquinone, isoprene, limonene, 4-methylcatechol, styrene, toluene, xylene
Noncarcinogens: N = 8	acrolein, biphenyl, choline, eugenol, nicotinamide, nicotinic acid, phenol, piperidine
Uncertain:	caffeine
Yet to test:	about 1000 chemicals

Source: ***Carcinogenic Potency Database*** (http://potency.berkeley.edu; Gold & al. 1999; Gold & Zeiger 1997).