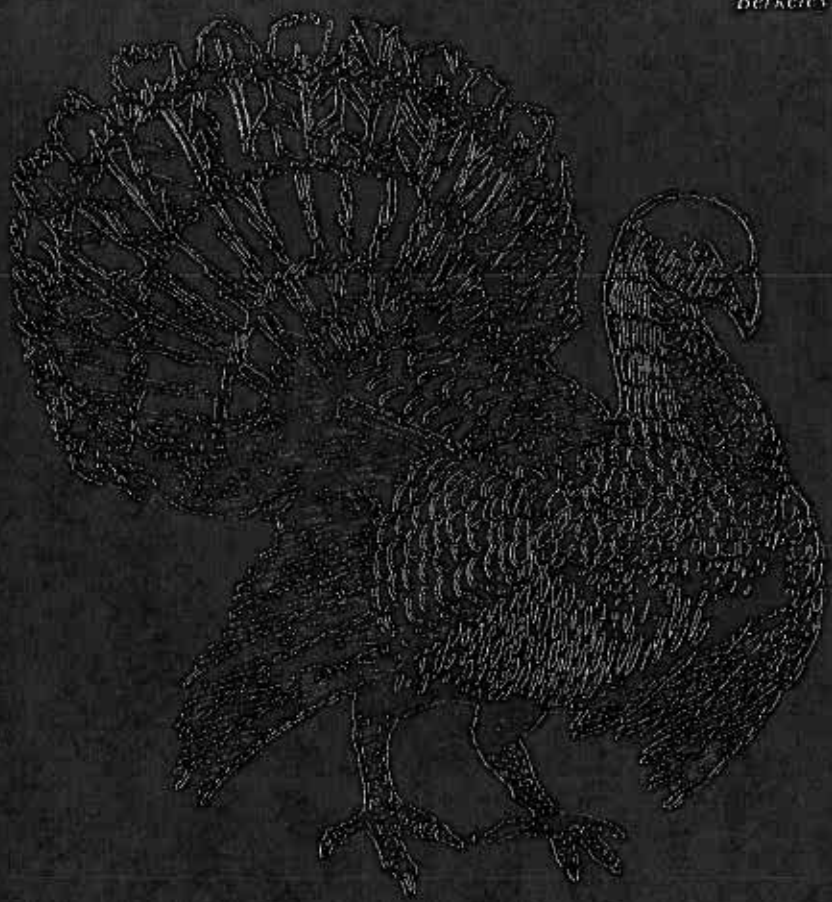
# Holiday Dinner Menu

"No human diet can be free of naturally occurring chemicals that are rodent carcinogens. Of the chemicals that people eat, 99.99% are natural."

—Dr. Bruce Ames and Dr. Lois Swirsky Gold, University of California, Berkeley



AMERICAN COUNCIL ON SCIENCE AND HEALTH
Dr. Elizabeth M. Whelan, President

## Appetizers

CREAM OF MUSHROOM SOUP
*hydrazines*

## Fresh Relish Tray

CARROTS
*aniline, caffeic acid*

CHERRY TOMATOES
*benzaldehyde, caffeic acid, hydrogen peroxide, quercetin glycosides*

CELERY
*caffeic acid, furan derivatives, psoralens*

## Assorted Nuts

MIXED ROASTED NUTS
*aflatoxin, furfural*

## Green Salad

TOSSED LETTUCE AND ARUGULA WITH BASIL-MUSTARD VINAIGRETTE
*allyl isothiocyanate, caffeic acid, estragole, methyl eugenol*

## Entrees

ROAST TURKEY
*heterocyclic amines*

BREAD STUFFING
(with onions, celery, black pepper & mushrooms)
*acrylamide, ethyl alcohol, benzo(a)pyrene, ethyl carbamate, furan derivatives, furfural, dihydrazines, d-limonene, psoralens, quercetin glycosides, safrole*

CRANBERRY SAUCE
*furan derivatives*
or

PRIME RIB OF BEEF WITH PARSLEY SAUCE
*benzene, heterocyclic amines, psoralens*

## Vegetables

BROCCOLI SPEARS
*allyl isothiocyanate*

BAKED POTATO
*ethyl alcohol, caffeic acid*

SWEET POTATO
*ethyl alcohol, furfural*

## Rolls with Butter

*acetaldehyde, acrylamide, benzene, ethyl alcohol, benzo(a)pyrene, ethyl carbamate, furan derivatives, furfural*

## Desserts

PUMPKIN PIE
*benzo(a)pyrene, coumarin, methyl eugenol, safrole*

APPLE PIE
*acetaldehyde, caffeic acid, coumarin, estragole, ethyl alcohol, methyl eugenol, quercetin glycoside, safrole*

## Fruit Tray

FRESH APPLES, GRAPES, MANGOS, PEARS, PINEAPPLE
*acetaldehyde, benzaldehyde, caffeic acid, d-limonene, estragole, ethyl acrylate, quercetin glycosides*

## Beverages

RED WINE, WHITE WINE
*ethyl alcohol, ethyl carbamate*

COFFEE
*benzo(a)pyrene, benzaldehyde, benzene, benzofuran, caffeic acid, catechol, 1,2,5,6-dibenz(a)anthracene, ethyl benzene, furan, furfural, hydrogen peroxide, hydroquinone, d-limonene, 4-methylcatechol*

TEA
*benzo(a)pyrene, quercetin glycosides*

# NATURALLY OCCURRING MUTAGENS AND CARCINOGENS FOUND IN FOODS AND BEVERAGES

**ACETALDEHYDE** *(apples, bread, coffee, meat, tomatoes)*—mutagen and potent rodent carcinogen

**ACRYLAMIDE** *(bread, rolls)*—rodent and human neurotoxin; rodent carcinogen

**AFLATOXIN** *(nuts)*—mutagen and potent rodent carcinogen; also a human carcinogen

**ALLYL ISOTHIOCYANATE** *(arugula, broccoli, mustard)*—mutagen and rodent carcinogen

**ANILINE** *(carrots)*—rodent carcinogen

**BENZALDEHYDE** *(apples, coffee, tomatoes)*—rodent carcinogen

**BENZENE** *(butter, coffee, roast beef)*—rodent carcinogen

**BENZO(A)PYRENE** *(bread, coffee, pumpkin pie, rolls, tea)*—mutagen and rodent carcinogen

**BENZOFURAN** *(coffee)*—rodent carcinogen

**BENZYL ACETATE** *(jasmine tea)*—rodent carcinogen

**CAFFEIC ACID** *(apples, carrots, celery, cherry tomatoes, coffee, pears, grapes, lettuce, mangos, potatoes)*—rodent carcinogen

**CATECHOL** *(coffee)*—rodent carcinogen

**COUMARIN** *(cinnamon in pies)*—rodent carcinogen

**1,2,5,6-DIBENZ(A)ANTHRACENE** *(coffee)*—rodent carcinogen

**ESTRAGOLE** *(apples, basil)*—rodent carcinogen

**ETHYL ALCOHOL** *(bread, red wine, white wine, rolls,*

# OODS ARE NOT OGEN-FREE

a "carcinogens" out of our processed food supply, it was assumed that carcinogens (a) were rarely found in foods and (b) were put there by humans, either purposely, through food additives, or inadvertently, in the form of pesticide residues. The Delaney amendment banned from American food any artificial substance that could be shown to cause cancer in lab animals—no matter how small the amount of the substance in a food or how high the dose given to test animals. Some progress has been made since 1958, however: In 1996 the Food Quality Protection Act removed the scientifically untenable "zero-risk" requirement from the approval process for pesticides. This narrowed the scope of the irrationally restrictive Delaney clause.[1]

In the 40+ years since Delaney was passed, it has become clear that many naturally occurring chemicals—chemicals that are plentiful in our food supply—cause cancer in rodents when fed in high doses over a lifetime. Furthermore, scientists Bruce N. Ames and Lois Swirsky Gold have analyzed human exposure to chemicals, both natural and man-made (synthetic), that have been classified as "rodent carcinogens." The researchers have concluded that when ranked on an index (the HERP Index) that compares human exposure to the dose that increases tumors in rodents, the possible cancer hazard to humans from the background of dietary intake of nature's own rodent carcinogens ranks high in comparison to the possible hazard from residues of synthetic pesticides or additives.

Human dietary intake of nature's pesticides is about 10,000 times higher than human intake of synthetic pesticides that are rodent carcinogens. In

## ARE THERE "POISONS" IN OUR FOOD SUPPLY?

The focus of the ACSH holiday menu is on "carcinogens," defined here as chemicals, either natural or synthetic, that cause cancer in rodents when consumed in large amounts. A related topic, however, is that of "poisons," technically known as toxicants. Just as it is scientifically unwarranted to believe that the food supply is free of natural rodent carcinogens and mutagens, it is equally unrealistic to equate "natural" with safe. Foods abound in natural chemicals that are toxic or potentially toxic—because all chemicals will be toxic at some dose.

Toxicologists have confirmed that food naturally contains a myriad of chemicals traditionally thought of as "poisons." Potatoes contain solanine, arsenic, and chaconine. Lima beans contain hydrogen cyanide, a classic suicide substance. Carrots contain carototoxin, a nerve poison. And nutmeg, black pepper, and carrots all contain the hallucinogenic compound myristicin.

Moreover, all chemicals, whether natural or synthetic, are potential toxicants at high doses but are perfectly safe when consumed in low doses. Take common table salt, for example: This everyday chemical, when consumed in excess, can cause elevations in blood pressure in sensitive individuals; a couple of tablespoonsful can kill a small child. Selenium, a mineral essential in the human diet, can cause nausea and nerve changes when chronically consumed in excess. The familiar stimulant caffeine is also a toxicant if consumed in high doses (say, 50 to 100 cups of coffee per day). Supplements of the essential mineral iron all too often cause poisoning in children.

When it comes to toxicants in the diet—natural or synthetic—the dose makes the poison.

(*continued from page 3*)

**ETHYL ACRYLATE** *(pineapple)*—rodent carcinogen

**ETHYL BENZENE** *(coffee)*—rodent carcinogen

**ETHYL CARBAMATE** *(bread, rolls, red wine)*—mutagen and rodent carcinogen

**FURAN AND FURAN DERIVATIVES** *(bread, onions, celery, mushrooms, sweet potatoes, rolls, cranberry sauce, coffee)*—many are mutagens

**FURFURAL** *(bread, coffee, nuts, rolls, sweet potatoes)*—furan derivative and rodent carcinogen

**HETEROCYCLIC AMINES** *(roast beef, turkey)*—mutagens and rodent carcinogens

**HYDRAZINES** *(mushrooms)*—mutagens and rodent carcinogens

**HYDROGEN PEROXIDE** *(coffee, tomatoes)*—mutagen and rodent carcinogen

**HYDROQUINONE** *(coffee)*—rodent carcinogen

**D-LIMONENE** *(black pepper, mangos)*—rodent carcinogen

**4-METHYLCATECHOL** *(coffee)*—rodent carcinogen

**METHYL EUGENOL** *(basil, cinnamon, and nutmeg in apple and pumpkin pies)*—rodent carcinogen

**PSORALENS** *(celery, parsley)*—mutagens; rodent and human carcinogens

**QUERCETIN GLYCOSIDES** *(apples, onions, tea, tomatoes)*—mutagens and rodent carcinogens

**SAFROLE** *(nutmeg in apple and pumpkin pies, black pepper)*—rodent carcinogen



recommend that you worry about this hypothetical risk) should understand that the human diet is full of naturally occurring rodent carcinogens.

Present scientific knowledge suggests that residues of synthetic rodent carcinogens in our diet are unlikely to pose a risk of cancer in the quantities we consume on a daily, monthly, or yearly basis. The data are inadequate to allow us to evaluate human risk at low doses, and the uncertainties are enormous.

We hear much about "carcinogens" in our food. But the media use the designation "carcinogen" most frequently in conjunction with man-made rodent carcinogens—substances such as Alar (a fruit-ripening chemical), saccharin (a synthetic, noncaloric sweetener), and BHA (butylated hydroxyanisole, a synthetic antioxidant). What ACSH will demonstrate in this menu is that chemicals that are rodent carcinogens, or that are suspected of being such, abound in nature.

Many of these naturally occurring rodent carcinogens are natural pesticides—chemicals that plants produce to repel or kill predators. Of the approximately 10,000 such natural pesticides occurring in the diet, only about 60 have been tested in rodent experiments.[2] These chemicals are found in a wide variety of our food plants: Brussels sprouts, cantaloupe, cauliflower,

The consumption of small doses of rodent carcinogens, whether of natural or synthetic origin, is quite unlikely to pose a cancer hazard to humans. When you understand that carcinogens and mutagens are everywhere in Mother Nature's own food supply, you can see the absurdity of panicking over tiny levels in the food supply of synthetic chemicals (such as pesticide residues) that are "carcinogens" when fed in large doses over a lifetime to rodents. If you chose to believe that every rodent carcinogen was also a potential human carcinogen, and if you then chose to extrapolate directly from rodent to human, the background of naturally occurring chemicals that people consume at levels close to the rodent-carcinogenic dose would still cast doubt on the importance for human cancer of synthetic chemical residues.

Note, for example, on the Holiday Menu that the bread in the stuffing contains furfural, a rodent carcinogen. But when you take into account the difference in body weight between a human and a rodent, you will see that, based on the carcinogenicity data available from the laboratory, a person would have to eat 82,600 slices of bread to consume an amount of furfural equal to the amount that increased the risk of cancer in rodents.

Here's a calculation relating the rodents' risk to yours:

1 slice white bread contains 167 µg (micrograms) furfural.
Rodent carcinogenic dose of furfural =
197 mg (milligrams)/kg (kilogram) body wt/day,
which is the same as 197,000 µg/kg/day.
Equivalent human dose (for a 70 kg person, about 155 pounds) =

$$\frac{197{,}000 \times 70}{167} = 82{,}600 \text{ slices of bread/day.}$$

When looking at this example, remember the conditions of the animal studies: Doses are fed every day of the rodent's life (usually two years). To get an equivalent carcinogenic dose, a human would have to consume those 82,600 slices of bread every day for years.

The primary risk factor in holiday meals—other than the risk of food poisoning from the improper handling or preparation of food—is getting too much of a good thing. A hungry holiday eater can easily consume 2,000-plus calories at one sitting. A consistent intake of excessive calories contributes to obesity, with its attendant higher risk of heart disease. Interestingly, excessive caloric intake has been called the "most striking" carcinogen in rodent carcinogenicity studies. Body weight is a good predictor of a rat's risk of cancer as shown in comparisons of rats on calorie-restricted diets and rats permitted to eat all they want.

In our quest to reduce our cancer risk by manipulating our diet, we should focus on dietary imbalances in what we eat, not on trace chemicals. Numerous epidemiological studies have indicated that people who consume a diet high in fruits and vegetables have a lower risk for various types of cancer. This is true in spite of the fact that natural chemicals that are also rodent carcinogens occur abundantly in many of these same fruits and vegetables. Note that the populations studied lowered their risks even though their food presumably contained synthetic pesticide residues. High fruit and vegetable consumption was still protective against cancer.

The foods on our Holiday Menu are healthful and wholesome despite the presence in them of some of Mother Nature's own chemicals that have been shown to be carcinogenic in high-dose rodent tests.

## NATURAL VERSUS SYNTHETIC

The presumption that natural chemicals are not hazardous but synthetic ones are has no scientific support. Substances should be evaluated according to their human carcinogenic potential, not according to their origin—and to do so requires more biological information than can be provided by a rodent cancer test.

Naturally occurring rodent carcinogens are present in far greater amounts in our food supply than are pesticide and other chemical residues (the much-publicized rodent carcinogens). As we enjoy our holiday dinner, we should remember the benefits that scientific research has brought to American agriculture and food technology. Science has made our food safer, more nutritious, more attractive, more abundant, more widely available, and more enjoyable—and has done so at relatively low cost. The American food supply is truly the envy of the world!



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chemicals available to farmers
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increase. Such a situation coul
increase cancer rates if people
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fewer fruits and vegetables.

## ACSH'S REVIEW
## OCCURRIN
## THREE

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natural chemical that tests pos
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cinogen. Even though we kno
can, in high doses, cause huma
would we want to dispense wi
production of vitamin D under
is important to emphasize that
carcinogens, as with synthetic
the "dose makes the poison."

Second, scientists are jus
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nature's own rodent carcinoge
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are the only rodent carcinogen
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Indeed, a recent review o
cinogen studies demonstrated th
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occurring and synthetic carcinogens. Of the thousands of natural pesticides identified, fewer than 100 have been investigated adequately in rodent tests.[2]

All of our efforts to reduce risks of cancer should:

- focus first and foremost on substances and conditions of exposure that have been shown in human epidemiological studies to cause cancer. The use of tobacco (particularly cigarettes), overexposure to sunlight, and dietary imbalances are examples of "cancer risk factors" well studied in humans, not just in laboratory rodents.[5]
- emphasize dietary patterns, such as increasing consumption of fruits and vegetables, that have been shown in human epidemiological studies to decrease cancer risk.
- reject "carcinogen-of-the-week" scares—those hyped indictments of artificial sweeteners, pesticides, food colorings, and other synthetic ingredients that at high doses cause cancer in rodents.
- demand that our government's regulatory efforts to reduce cancer risk be based on sound science, not on emotion or on the sort of neo-Luddite ideologies that reject our technological, industrial way of life.

1 The Food Quality Protection Act of 1996 actually moved regulation of pesticide residues on processed foods from section 409 of the Food, Drug, and Cosmetic Act, where the Delaney clause is placed, to section 408. The effect of this change is that the provisions of the Delaney clause no longer apply to pesticide residues, although they do still apply to food additives.

2 Gold LS, Slone TH, Ames BN. Prioritization of possible carcinogenic hazards in food. In: Tennant DR, ed. Food Chemical Risk Analysis. London: Chapman & Hall; 1997:269–295.

3 Data for calculations obtained from: Gold LS, Slone TH, Stern BR, Manley NB, Ames BN. Possible carcinogenic hazards from natural and synthetic chemicals: setting priorities. In: Cothern CR, ed. Comparative Environmental Risk Assessment. Boca Raton, FL: Lewis Publishers; 1993:209–235.

4 Gold LS, Slone TH, Ames BN. What do animal cancer tests tell us about human cancer risk?: Overview of analyses of the carcinogenic potency database. Drug Metab Rev. 1998;30(2):359–404.

5 ACSH does not here reject the use of animal testing for the prediction of human cancer risk, but rather calls for common sense in assessing the results of such tests (for details, see the ACSH booklet *Of Mice and Mandates*). Further research is needed to establish the mechanisms by which different chemicals, whether natural or synthetic, cause cancer. Without such work we have no sound scientific basis for extrapolating from high-dose rodent tests to the much lower doses typically seen in human exposures. ACSH specifically rejects extrapolating from high-dose rodent cancer tests to predict cancer risk in humans. ACSH notes, however, that a chemical, whether natural or synthetic, that causes cancer in many animal species (not just in rodents) at many levels of exposure and in many experiments should be given regulatory attention. ACSH notes further that consideration should be given to setting human tolerance levels to such an animal carcinogen. This rational and reasonable approach is now followed by government agencies in the case of one natural (and usually unavoidable) carcinogen, aflatoxin, a substance produced by a fungus that grows naturally on peanuts, corn, and other products. The Food and Drug Administration, noting the potency of this

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*allyl isothiocyanate*

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*ethyl alcohol, caffeic acid*

SWEET POTATO
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*acetaldehyde, acrylamide, benzene, ethyl alcohol, benzo(a)pyrene, ethyl carbamate, furan derivatives, furfural*

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## Fruit Tray

FRESH APPLES, GRAPES, MANGOS, PEARS, PINEAPPLE
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