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AS WE SEE IT

Carcinogens Are Everywhere, But Do You Have To Worry?

A growing number of Americans are modifying their lifestyle to avoid exposure to toxic chemicals.¹ Those seeking to maintain good health are staying away from cigarette smoke, tap water, gene-mutating foods and other carcinogen carriers.

Despite these heroic efforts, two newly released studies show that our bodies have become toxic chemical repositories.

After decades of studying carcinogens in air, water and food, scientists can now measure the magnitude of chemical contamination in human beings via blood and urine tests.² It turns out that even health conscious people have become significant pollution sites.

The first study was led by Mount Sinai School of Medicine in New York and tested for 210 different chemicals.³ This was the largest analysis of commonly found industrial chemicals ever surveyed in humans. The findings revealed that the subjects contained an average of 91 compounds, most of which did not exist 75 years ago. Of these toxic compounds, 76 of them have been linked to cancer and all test subjects carried them. There was a high prevalence of polychlorinated biphenyl (PCB) contamination, a potent carcinogen that was banned in the U.S. in 1976, but is used in other countries and resides in the environment for decades.

The second study was conducted by the Centers for Disease Control and Prevention (CDC).⁴ That study provided statistical data relevant to U.S. body burdens of 116 different chemicals and confirmed many of the findings of the first study. Taken together, these two independent studies document that the bodies of U.S. citizens have become contaminated with a myriad of lethal chemicals. When one considers the hundreds of billions of dollars spent by the Environmental Protection Agency (EPA), the Food and drug Administration (FDA) and other regulatory agencies, it becomes acutely obvious that the government has utterly failed to protect the public from exposure to these environmental carcinogens.

In a statement released by a non-profit organization called the Environmental Working Group (which organized the first study), they declare:

"People are loaded with chemicals. Some are known carcinogens, and many are banned. There are some about which science knows virtually nothing when it comes to potential health effects. We need a modern, common sense approach to identifying and protecting the public from possible health effects from long-term exposure to low levels of multiple chemicals."⁵

A contrary view

Dr. Bruce Ames is considered one of the foremost experts on gene mutation. One of Dr. Ames' most notable accomplishments is the invention of the "Ames test" that measures the gene mutating effects of different compounds, such as environmental carcinogens.

Dr. Ames has extensively published material about natural carcinogens that cause cancer in laboratory rodents, or have been shown to mutate genes when tested with bacteria (Ames test).⁶





It is Dr. Ames' contention that even if we could eliminate all synthetic carcinogens, we would still be exposed to many other natural carcinogens through our diet.⁶ According to Dr. Ames, there are naturally occurring chemicals even in the healthy food we eat that have either been shown to be carcinogenic in laboratory rodents or have been shown to be "mutagens" because they can damage DNA genes. Mutagens can also be thought of as possible carcinogens.^{7,8,9} Mutagen tests such as the Ames test are often used as quick indicators to predict how likely a chemical is to cause cancer. It has become clear that many naturally occurring chemicals, which are plentiful in our food supply, cause cancer in rodents when fed in high doses over the animal's lifetime.¹⁰

For example, plants that humans eat produce natural pesticides that throughout evolution have enabled them to survive insect attack. Human dietary intake of these natural pesticides is about 10,000 times higher than human intake of synthetic pesticides (classified as rodent carcinogens.)⁶ In other words, consumers who choose to worry about eating synthetic chemicals shown to cause cancer in rodents should understand that the human diet is full of naturally occurring chemicals also shown to cause cancer in rodents.¹¹

Dr. Ames and his associates do not believe that the residues of synthetic rodent carcinogens in our diet are likely to pose a risk of cancer in the quantities we consume on a daily, monthly, or yearly basis.¹² Conversely, they point to the many naturally occurring carcinogens that are natural pesticides-chemicals that plants produce to repel or kill predators. Of the approximately ten thousand such natural pesticides occurring in the diet, only about 60 have been tested in rodent experiments. These chemicals are found in a wide variety of our food plants: Brussels sprouts, cantaloupe, cauliflower, cherries, chili peppers, cocoa, garlic, grapes, kale, lentils, lettuce, and radishes-to name just a few.

Dr. Ames believes that the consumption of small doses of rodent carcinogens, whether of natural or synthetic origin, is unlikely to pose a cancer hazard to humans.^{13,14,15} The simple fact is that carcinogens and mutagens are everywhere in Mother Nature's own food supply.

Dr. Ames casts doubt on the true danger of rodent carcinogens based on how the rodent studies were done in relationship to what humans would consume in the real world. For example, bread contains a potent rodent carcinogen called furfural. But when the difference in body weight between a human and a rodent is taken into account, based on the data available from the laboratory, a person would have to eat 82,600 slices of bread per day for years to consume an amount of furfural equal to the amount that increased the risk of cancer in rodents.

Reducing food intake

Dr. Ames does point a finger at the high calorie diet that has become commonplace in the United States. A consistent intake of excessive calories contributes to obesity, with its associated higher risk of heart disease, cancer and many other diseases.¹⁶ 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 versus those on an unrestricted diet (rats permitted to eat all they want.)

According to Dr. Ames, in our quest to reduce cancer risk by manipulating our diet, we should focus on dietary imbalances in what we eat, not on trace chemicals.¹⁷ Numerous epidemiological studies have indicated that people who consume a diet high in fruits and vegetables have a lower risk of various types of cancer.¹⁸ 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.¹⁹ Note that the population studied lowered their risk of cancer even though their food presumably contained synthetic pesticide residues, suggesting that high fruit and vegetable consumption was still protective against cancer.²⁰

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Carcinogens Are Everywhere, But Do You Have To Worry?

Dr. Ames' suggestion for cancer prevention

Dr. Bruce Ames has been a long-time proponent of using DNA-protecting nutrients, like folic acid, to neutralize the effects of natural and synthetic carcinogens. His contention is that since it is impossible to avoid the thousands of carcinogens present in our diet, the best we can do for now is to protect our precious genes against mutation. 21-25

The most impressive study on folic acid showed that women who consumed folic acid supplements for at least 15 years reduced their risk of colon cancer by an astounding 75%. The fact that there were 88,756 women participating in the study makes this finding especially significant. The authors explain that folic acid obtained from supplements showed a stronger protective effect against colon cancer than folic acid consumed in the diet. This study also helps to confirm the work of Dr. Ames, who has authored numerous articles showing that folic acid is extremely effective in preventing the initial DNA mutations that can lead to cancer later in life. This data came from the famous Nurses' Health Study conducted at the Harvard Medical School.²⁶ This study demonstrated that the degree of protection against cancer is correlated with how long a DNA-protecting substance (such as folic acid) is consumed. The women who took more than 400 micrograms of folic acid per day for 15 years experienced the 75% reduction in colon cancer, whereas short-term supplementation produced only marginal protection.

SOME NATURALLY OCCURRING MUTAGENS and CARCINOGENS FOUND in FOODS and BEVERAGES *

Acetaldehyde
(apples, bread, coffee, 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

Evidence is growing that low levels of folic acid may be a factor in the cause of several cancers. Supplementation with folic acid has been shown to be protective against the development of breast cancer particularly in women who are on estrogen replacement therapy, drink alcohol or use tobacco. A 16-year study of 88,818 women showed that those who drank alcohol reduced their risk of breast cancer by 50% when they took folic acid (600 mcg/day).²⁷ A 12-year Mayo Clinic study of over 40,000 women aged 55 to 69 found that women who drank alcohol were at no greater risk of breast cancer as long as they maintained normal folic acid levels.²⁸

Scientists in the Netherlands have found that folic acid, vitamin C, and the carotenoid, beta-cryptoxanthin are protective against lung cancer. This large prospective study, consisting of 58,279 men of ages 55 to 69 years, found that high folic acid intake reduced the risk of small cell, squamous cell and adeno carcinomas of the lung.²⁹

Researchers at Yale University found that people who consumed nutrients such as folic acid, vitamins C, B6, beta-carotene and fiber had a lower risk of cancers of the esophagus and stomach. A 1988 study showed an association of folic acid deficiencies with abnormalities in esophageal cells in those people at risk for esophageal cancer. There were significantly lower concentrations of folic acid present in the blood of patients with cellular dysplasia or malignancy than in cells of normal patients.³⁰

Studies show that lower levels of folate and antioxidants increases the risk of cervical cancer. In a study at the University of Alabama in Birmingham, women whose cervical cells were loaded with folate were two to five times less likely than women with low folate levels to develop cervical dysplasia, the precursor of cervical cancer. [Cervical cancer is now considered a sexually transmitted disease associated with certain strains of human papilloma virus (HPV), or genital warts. In a group of 324 women with cervical cancer and HPV, statistically lower levels of folic acid were found.]

Pancreatic cancer is almost universally fatal, yet a study of 29,133 healthy male smokers showed that those with the lowest folic acid intake were 48% more likely to contract pancreatic cancer.³¹

(coffee)-rodent carcinogen

Benzyl acetate

(jasmine tea)-rodent carcinogen

1,2,5,6-dibenz(a)anthracene (coffee)-rodent carcinogen

Estragole

(apples, basil)-rodent carcinogen

Ethyl alcohol

(bread, red wine, rolls)-rodent and human carcinogen

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, overcooked fish)

-mutagens and rodent carcinogens

Hydrazines

(mushrooms)-mutagens and rodent carcinogens

Hydrogen peroxide

(coffee, tomatoes)-mutagen and rodent carcinogen

Hydroquinone

(coffee)-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

Safrole

(nutmeg in apple and pumpkin pies, black pepper)
-rodent carcinogen

While studies show that as little as 400 mcg per day of folic acid confers a cancer-protection benefit, most Life Extension members take 800 mcg, and sometimes, higher amounts per day.

A prudent course

We now know that our bodies have been inundated by significant amounts of natural and synthetic carcinogens. Two startling new studies show that we are already loaded with synthetic carcinogens that are not readily removed from the body.

Two of the participants in the Mt Sinai School of Medicine study² were astounded when they were told that they had over 100 different carcinogens in their bodies, even though they regularly ate organic produce, avoided red meat, and kept pesticides out of their homes.*

There are some common sense lifestyle modifications that can reduce the carcinogen burden. For example, acrylamide³² is a newly identified carcinogen found in foods such as potato chips, french fries, certain highly cooked breads and cereals. The media reported widely on the potential risks of acrylamide and we carried an article about it in the February 2003 issue of this publication. Since then, some scientists have sought to refute the purported dangers of acrylamide. Whatever the dangers of acrylamide turn out to be, it makes sense to avoid potato chips and French fries because they contain artery-clogging trans fatty acids and obesity-inducing carbohydrates. This fact holds true for most breads and any food that is cooked at extremely high temperature.

It has long been known that heavily cooked foods inflict massive damage to the genes. A group at the University of Minnesota reported that women who ate overcooked hamburgers had a 50% greater risk of breast cancer than women who ate rare or medium hamburgers. The famous Iowa Women's Health Study found that women who consistently eat well-done steak, hamburgers and bacon have a 4.62-fold increased risk of breast cancer.³³

Cooking foods at high temperatures causes the formation of gene-mutating heterocyclic amines, which is why deep fried foods are so dangerous to eat. Heterocyclic amines have been linked to prostate, breast, colorectal, esophageal, lung, liver and other cancers. While health conscious people try to avoid foods that are known carcinogens, even grilled salmon contains a potent dose of gene-mutating heterocyclic amines.³⁴

While one can reduce their exposure to cancer-causing heterocyclic amines, it may be impossible to keep them from forming within the body. Enzymatic activities that naturally occur in the liver can inadvertently manufacture heterocyclic amines from otherwise harmless organic compounds.³⁵

The carcinogenic dangers of heterocyclic amines have been discussed in previous issues of Life Extension magazine. Heterocyclic amines, however, are not the only dietary culprit involved in gene mutation. Other mutagenic agents found in food include nitrosamine preservatives, aflatoxin molds and pesticide and herbicide residues.

It makes sense to avoid unhealthy foods that also contain known carcinogens, but since even healthy fruits and vegetables contain some

DIFFICULTY IN EXTRAPOLATING RODENT STUDIES TO HUMANS

When laboratory studies are conducted to test if natural or synthetic chemicals cause cancer in rodents, the scientists use very high amounts of the suspected carcinogen.*

Moreover, most chemicals, whether natural or synthetic,

*(References can be found at <http://www.acsh.org/>, or you may just want to browse the entire website.)

carcinogens, one cannot possibly completely avoid them. The bottom line is that we need to eat a certain number of calories and this inevitably exposes

are potential toxicants at high doses but may be perfectly safe when consumed in low doses.**

us to agents that could cause cancer. A consistent finding in epidemiological studies is that people who consume the most calories have significantly higher incidences of cancer. There are several mechanisms that can explain why overeating causes cancer, but one mechanism is that more gene mutations occur in response to higher food intake.

**Ames BN, Gold LS, Shigenaga MK. Cancer prevention, rodent high-dose cancer tests, and risk assessment. Risk Analysis, 1996, 16(5): 613-17.*

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Since avoiding all dietary carcinogens cannot be done, identifying methods to neutralize their gene mutating effects becomes a critical part of a life extension program.

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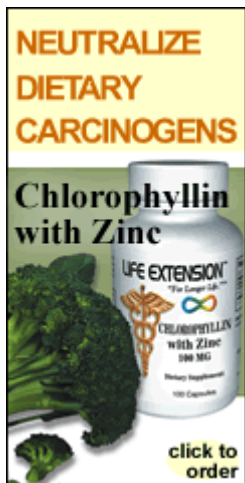
Carcinogens Are Everywhere, But Do You Have To Worry?

Neutralizing carcinogens

The first lines of defense against the many carcinogens consumed in the diet are agents that prevent gene mutation. Many anti-mutagenic agents have been identified in fruits and vegetables, the most potent being indole-3-carbinol and chlorophyllin.³⁶ Dietary antioxidants should be considered a secondary line of defense against cancer, since it is more important to inactivate or neutralize carcinogens in the first place than to try to protect the cells and proteins downstream from their effects.

Chlorophyllin is the modified, water-soluble form of chlorophyll that has been tested as an anti-mutagenic agent for more than 20 years. There is a very large body of data concerning the anti-cancer and anti-mutagenic effects of chlorophyllin, but much less information on the effects of chlorophyll itself.^{36,37}

For example, chlorophyllin can cross cell membranes, organelle membranes and the blood-brain barrier, while chlorophyll cannot. Chlorophyllin enters even into the mitochondria, the energy-producing organelles of the cell where the majority of free radicals are produced.^{38,39} Chlorophyllin protects mitochondria from a variety of external chemical, biological and radiation insults.³⁸⁻⁴⁰



The Life Extension Foundation introduced members to the anti-mutagenic effects of chlorophyllin back in 1989. The recommendation to supplement with chlorophyllin was based on a study published in the journal *Mutation Research* (1986 Feb;173(2):111-5) showing that this plant extract was a more effective anti-mutagenic agent than all other known anti-cancer vitamins at that time.

What impressed us most about the *Mutation Research* study was that chlorophyllin suppressed the mutagenic activity of carcinogens such as fried pork, diesel emissions and coal dust by more than 90%! No other supplement came close to chlorophyllin's ability to inhibit deadly gene mutations.

The great majority of studies about chlorophyllin's health benefits concern its anti-mutagenic and anti-carcinogenic properties. Chlorophyllin 'traps' heterocyclic hydrocarbon carcinogens by reacting with their 'backbone,' making it impossible for them to form adducts with DNA.^{41,42}

The most notorious of all human dietary carcinogens are aflatoxin B-1 and aflatoxin B-2. These aflatoxins occur all over the world in fungus-infected rice, wheat, rye and other staple grains, and they have been found in a variety of U.S. crops. Aflatoxin-infected crops are more of a problem in third world countries such as

China, where in certain provinces the farmers there experience the highest liver cancer rates in the world.⁵⁵

In a landmark study, researchers demonstrated a 55% reduction in aflatoxin urinary biomarkers compared to controls by giving the farmers 100 mg of chlorophyllin three times a day with their meals. The scientists estimated that the induction period needed for this type of cancer to develop was extended from 20 years to 40 years by supplementing with chlorophyllin. The authors noted that chlorophyllin tablets are the least expensive and most cost-effective means of preventing these types of cancers⁴⁸⁻⁵⁵ It should be noted that there is a powerful relationship between dietary aflatoxin reduction, DNA adducts, and the lowering of cancer rates in both humans and animals.^{9,21-23,30}

A study compared the anti-cancer properties of green tea, black tea and chlorophyllin.⁴¹ The conclusion of this study and the other studies comparing teas and chlorophyllin are that chlorophyllin is a far more potent anti-mutagenic agent, protecting against a far wider range of carcinogens than tea.⁴¹ In one study, teas did not degrade at all the mutagen N-hydroxy-IQ found in cooked meat, while with chlorophyllin it was rapidly degraded.

In human breast cell studies, chlorophyllin was one of the most effective compounds protecting against DNA adduct formation, inhibiting adduct formation by 65%.⁵⁶

In vitro studies with chlorophyllin show it to be an inhibitor of the cytochrome P-450 liver enzymes.⁵⁷ All of the in vivo [whole animal] studies where cytochrome P-450 enzyme activity is reduced resulted in lower cancer rates and longer life span.³⁵



Chlorophyllin is a low cost and widely available dietary supplement. It is especially important to take 100 mg of chlorophyllin with foods that are heavily cooked, as this is where exposure to most carcinogens occurs.

Additional protection against carcinogens

Indole-3-carbinol (I3C) is found in anti-cancer vegetables such as cabbage, cauliflower and broccoli. When I3C is given to rodents before they are treated with cancer-causing chemicals (carcinogens), up to 90% of the cases of mammary cancer that would ordinarily develop do not. If I3C is given at the same time as cancer-causing chemicals, the number of tumors can be reduced by 96%.

High levels of toxic rocket fuel found in lettuce

Eating lettuce or other vegetables grown in fields irrigated by the Colorado River may expose consumers to a larger dose of toxic rocket fuel than is considered safe by the U.S. Environmental Protection Agency, according to test data and documents obtained by the Environmental Working Group (www.ewg.org).

Test results, never before made public, show that leafy vegetables grown with contaminated irrigation water take up, store and concentrate potentially harmful levels of perchlorate, a thyroid toxin that is the main explosive ingredient of rocket and missile fuel.

According to the Wall Street Journal (Jan 30, 2003), this rocket fuel ingredient (perchlorate) has contaminated numerous drinking water wells in Southern California, Southern Nevada and Arizona. Vegetables grown along the Colorado River are shipped to consumers throughout the United States, and thus even people who eat organic vegetables cannot escape perchlorate contamination in these areas.

The estimated cost to clean up these polluted wells is 19 billion dollars, but only 220 million dollars a year is being spent. At this rate, it will take 86 years to remove just this one toxic agent from the water in these polluted areas.

One of the ways I3C protects cells against cancerous changes is by preventing DNA damage. I3C protects DNA not only in breast tissue, but in other tissues as well. A study from the Medical College of Ohio shows that I3C can cut the rate of DNA damage from chemicals in breast tissue by almost 92%.⁵⁸ Others have shown that I3C decreases DNA damage in white blood cells by 82%, colon 67% and liver 69%. This would seem almost unbelievable if it hadn't been confirmed by others who have shown that I3C can reduce DMBA-induced liver adducts by 90%, lung and trachea by 55% and other tissues by similar amounts.⁵⁹

I3C's potential as a chemopreventive agent was confirmed in a study funded by the National Cancer Institute where 90 different cancer preventatives were put through six different tests of cancer prevention. Some of the other compounds shown to be effective in all six assays were folic acid, ascorbic acid and tocopherol succinate (vitamin E).

Another potential action of I3C against chemical cancers is its potential to keep dioxin and other chlorine chemicals out of cells. Dioxin is so toxic it is measured in parts per trillion. (Other toxic chemicals are measured in parts per billion.)

Dioxin latches onto a receptor on cells known as the aryl hydrocarbon receptor, through which it gains access into cells. I3C can partially block that receptor and keep dioxin out. In 1995, a national report published in six volumes was issued on the toxic effects of dioxin.⁶⁰ The main dietary source of dioxin is meat and dairy products. I3C not only protects cells against synthetic carcinogens like dioxin, but also dangerous natural carcinogens formed when meat is cooked, such as heterocyclic amines.

Depending on weight, most women take 400 mg a day of I3C, while most men take about 600 mg/day. When I3C initially came out in supplement form, it was prohibitively expensive. More efficient production methods have made it much more affordable.

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What Life Extension members should do

The press often comes up with a "carcinogen of the week" scare. These are easy stories to create because as you have just learned, carcinogens are literally everywhere.

Health conscious individuals should weigh the potential benefit of a food against its potential cancer risk. It certainly makes sense to minimize exposure to highly concentrated carcinogens like tobacco smoke, UV radiation from sunlight and overcooked foods. Even though fruits and vegetables contain some carcinogens, increased consumption of fruits and vegetables has been shown in human epidemiological studies to decrease cancer risk.

If we remember that all cancers are caused initially by mutations to our DNA genes, then we can fully appreciate the importance of consuming supplements that specifically protect our cells against these mutagenic agents. Antioxidants provide some protection by preventing gene-damaging free radicals that are generated by carcinogens. The three most important nutrients to guard our genes against carcinogens are chlorophyllin, folic acid and indole-3-carbinol (I3C). These supplements are inexpensive, yet may be the most effective means of protecting our cells against the hundreds of carcinogens we are inevitably exposed to every day.

Life Extension magazine cuts through media hype in order to inform members about practical solutions to prevent disease (such as cancer) and slow premature aging. When you read about a potential cancer risk in the mass media, seldom is there an in-depth analysis of what the real risk posed is, or what you can do to neutralize that risk. Life Extension members want the facts-which is what we seek to deliver with every issue of this magazine.

For longer life,



William Faloon

Chlorophyllin protects against many different carcinogens

There are over fifty cancer-causing agents known to occur in the human diet that chlorophyllin has been shown to protect against including:

- (1) benzo(a)pyrene⁴³⁻⁴⁵
- (2) DMBA [dimethylbenzanthracene] ⁴⁵⁻⁴⁷
- (3) dibenzopyrene^{38,46} TRP-P²³⁶
- (4) aflatoxin B-1 and aflatoxin B-²⁴⁸⁻⁵⁴
- (5) aminoanthracene ⁴⁵
- (6) 2-nitrofluorene ^{45, 52}
- (7) 1-nitropyrene ⁵²
- (8) 1-methyl-6-phenylimidazo [4,5-pyridine] [PHIP] ⁵³
- (9) 2-amino-3-methylimidazo[4,5-f]quinoline, [IQ] ⁴¹

Many of these carcinogens are found in ordinary broiled, boiled, baked and otherwise high-temperature cooked foods.³⁵ PHIP is considered the most abundant heterocyclic amine in fried ground beef.^{35,53} It causes

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colon cancers in F344 rats, and is considered a leading suspect as a cancer agent in man.^{35,53} Chlorophyllin (0.1%) in the drinking water of rats reduced aberrant crypt foci 50% in the colon when exposed to Phip [17]. In another study with F344 rats, a diet with 2000 parts per million (ppm) chlorophyllin significantly protected them from diethylnitrosamine-induced liver neoplasms.⁵⁴



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