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Advancing cancer prevention and survival through nutrition education and research.

The Five Worst Foods to Grill

A Report by The Cancer Project

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The Fourth of July is the most popular outdoor cooking holiday of the year, according to the Hearth, Patio, and Barbecue Association. Yet as Americans prepare to celebrate Independence Day, many are not aware that grilling some food items produces cancer-causing compounds called heterocyclic amines (HCAs).

Which grilled foods contain the highest levels of these carcinogens? To answer that question, dietitians with The Cancer Project took a closer look at America's most commonly grilled foods.

Findings

Cancer Project dietitians determined that many commonly grilled foods contain alarmingly high levels of HCAs. In January 2005, the federal government officially added HCAs to its list of known carcinogens.¹ Studies have shown that exposure to PhIP, one type of HCA, at levels as low as 10 to 20 nanograms per day is associated with roughly a doubling of breast cancer risk.^{2,3} Consuming HCAs also increases the risk of several other cancers, including colon cancer.⁴

This table lists the five foods containing the highest levels.

The Five Worst Foods to Grill	
Food Item	HCAs: nanograms per 100 grams*
Chicken breast, skinless, boneless, grilled, well done	14,000 nanograms/100 grams ⁵
Steak, grilled, well done	810 nanograms/100 grams ⁶
Pork, barbecued	470 nanograms/100 grams ⁷
Salmon, grilled with skin	166 nanograms/100 grams ⁸
Hamburger, grilled, well done	130 nanograms/100 grams ⁶
<i>*100 gram portion equals about 3.5 ounces grilled</i>	

Background: The Risks of Grilling Meat

Heterocyclic Amines (HCAs)

HCAs, a family of mutagenic and cancer-causing compounds, are produced when some meats, including chicken, beef, pork, and fish, are grilled, pan-fried, or broiled.⁹ HCAs can bind directly to DNA and cause mutations—the first step in cancer development.

Meat naturally contains amino acids and a protein called creatine that is found in muscle tissue. When meat is grilled, this combination of amino acids and creatine form HCAs.¹⁰ The major classes of HCAs include amino-imidazo-quinolines, or amino-imidazo-quinoxalines (collectively called IQ-type compounds), and amino-imidazo-pyridines (PhIP). Within these families, MeIQx and PhIP are the compounds found most abundantly in cooked meats.

Meat need not be well done or charred to contain HCAs. Testing has found HCAs in grilled chicken cooked for just three minutes on each side.¹¹

HCAs can pose a cancer risk even when consumed in small amounts. No safe level of PhIP, a common type of HCA linked to several forms of cancer, has been identified—it appears to increase cancer risk even at very low levels.

Polycyclic Aromatic Hydrocarbons (PAHs)

Grilling meat also produces other carcinogens. Grilling or broiling meat over a direct flame results in the production of Polycyclic Aromatic Hydrocarbons (PAHs). PAHs adhere to the surface of food; the more intense the heat, the more PAHs are present.¹² PAHs are widely believed to play a significant role in human cancers.¹³

Chicken and Fish

Some consumers mistakenly believe that chicken and fish are more healthful options than beef. Yet these products have about as much fat and cholesterol as beef, and grilled chicken and fish can contain even higher levels of HCAs than red meat does.

The Cancer Project's analysis has revealed that grilled chicken has more than 10 times the amount of HCAs in grilled beef; nearly all the HCAs detected were in the form of PhIP, which has been linked to increased risk of breast cancer, prostate cancer, and colon cancer.¹⁴ Fish showed significant HCA formation as well.¹⁵

Plant-Based Foods Do Not Contain HCAs

Creatine is found in muscle tissue, not in plant-based foods, so vegetarian foods do not produce detectable levels of HCAs when they are grilled.^{9, 16} These healthful grilling options include soy-based veggie burgers, vegetable kabobs, barbecued tofu, and portabella mushroom “steaks.” These foods are also low in fat and cholesterol.

Choosing plant-based foods also lowers cancer risk in other ways. Not only are vegetables low in fat and high in fiber, they also contain many cancer-fighting

substances. Carotenoids, the pigments that gives fruits and vegetables their dark colors, have been shown to help prevent cancer.¹⁷ Beta-carotene, present in dark green and yellow-orange vegetables, helps protect against lung cancer and may help prevent cancers of the bladder, mouth, larynx, esophagus, breast, and other sites. Many studies have found that diets rich in fruits and vegetables and low in animal fat cut cancer risks.

Safer Choices: What Should Go On the Grill?

Avid grillers need not throw away the barbecue: Grilling can provide healthful meals. Reducing exposure to carcinogens is as simple as grilling a veggie burger instead of a hamburger or a thick portabella mushroom instead of a steak. Cooks can marinate and prepare most of these veggie options just as they would with meats.

Here are five grilling ideas for this year's Fourth of July barbecue:

- Veggie burgers
- Vegetarian chicken patties
- Vegetable kabobs (sweet onions, pineapple, bell peppers, and broccoli—cooks should choose their favorite veggies and use their best-tasting marinade)
- Marinated portabella mushrooms (serve on bun as a sandwich or slice and eat as fajitas)
- Barbecue tofu or tempeh (place tofu in barbecue sauce and allow to marinate for two to three hours, grill, and serve with baked beans, corn, and a salad)

More healthy grilling ideas and recipes are available at www.CancerProject.org.

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