



A Guide to Grilling Food

Grilling or barbecuing meat at high temperatures leads to the production of heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs), compounds known as “mutagens” which damage DNA and may increase risk for developing cancer. HCAs are formed when amino acids and sugars present in meat react under high temperatures. Additionally, liquid fat drips into the flame of a barbeque and creates smoke filled with PAHs, coating the surface of the meat. While the best solution is to use other cooking methods when possible, there are several simple ways to balance the effects of grilling your favorite foods.

Choose meat wisely

Emphasize leaner cuts of meat. Less fat drippings means less smoke and less exposure to PAHs. Further, removing the skin from poultry before cooking will reduce HCA formation.

Marinate

Not only does marinating meat impart more flavor, it can also be protective against carcinogenic compounds. Acid-containing marinades (e.g., those containing vinegar or lemon/lime juice) are best to reduce formation of HCAs. It is also important to note that traditional barbeque sauces, which tend to have a high sugar content, can increase formation of HCAs. If using these sauces, they should be added to foods after they have been cooked.

Add herbs and spices

Herbs and spices have been shown to significantly reduce formation of HCAs when meats are grilled. Mint, onion, turmeric, garlic, rosemary, ginger, thyme, and red chili pepper are all great choices. These herbs can be used in marinades, mixed into ground meats, or used as a dry rub.

Avoid over-cooking or charring

The amount of time your meat contacts the grill makes a difference. Try quicker -cooking proteins like fish or shrimp, or cut your meats into smaller pieces to reduce cooking time (meat and vegetable kebabs are a great solution). Rotate meat frequently to allow the center to fully cook without overheating the surface. Blackened or charred areas of meat can be removed to reduce exposure to HCAs and PAHs.

Try grilling other food groups

Fruits and vegetables have been shown to inhibit activity of HCAs and reduce DNA damage caused by these compounds. Fortunately, antioxidant rich produce can also be delicious when grilled. Try zucchini, bell peppers, sweet potatoes, apples, peaches, pineapple, or even watermelon for a unique addition to your meal.



References

1. Cheng KW, Wu Q, Zheng ZP, Peng X, Simon JE, Chen F, Wang M. Inhibitory effect of fruit extracts on the formation of heterocyclic amines. *J Agric Food Chem.* 2007 Dec 12;55(25):10359-65.
2. Cross AJ, Sinha R. Meat-related mutagens/carcinogens in the etiology of colorectal cancer. *Environ Mol Mutagen.* 2004;44(1):44-55.
3. de Carvalho AM, Carioca AA, Fisberg RM, Qi L, Marchioni DM. Joint association of fruit, vegetable, and heterocyclic amine intake with DNA damage levels in a general population. *Nutrition.* 2016 Feb;32(2):260-4. doi: 10.1016/j.nut.2015.08.018.
4. Nagao M, Tsugane S. Cancer in Japan: Prevalence, prevention and the role of heterocyclic amines in human carcinogenesis. *Genes and Environment.* 2016;38:16. doi:10.1186/s41021-016-0043-y.
5. Nerurkar PV, Le Marchand L, Cooney RV. Effects of marinating with Asian marinades or western barbecue sauce on PhIP and MeIQx formation in barbecued beef. *Nutr Cancer.* 1999;34(2):147-52.
6. Richman EL, Stampfer MJ, Paciorek A, Broering JM, Carroll PR, Chan JM. Intakes of meat, fish, poultry, and eggs and risk of prostate cancer progression. *Am J Clin Nutr.* 2010;91(3):712-721.
7. Smith JS, Ameri F, Gadgil P. Effect of marinades on the formation of heterocyclic amines in grilled beef steaks. *J Food Sci.* 2008 Aug;73(6):T100-5.
8. Viegas O, Amaro LF, Ferreira IM, Pinho O. Inhibitory effect of antioxidant-rich marinades on the formation of heterocyclic aromatic amines in pan-fried beef. *J Agric Food Chem.* 2012 Jun 20;60(24):6235-40. doi:10.1021/jf302227b.