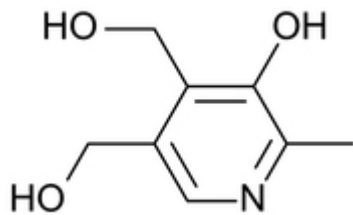


A fund-raising BBQ is a popular way of obtaining money for research into common cancers, in particular prostate and breast cancer.

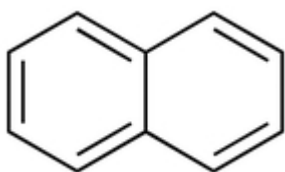
BBQs produce many toxic substances including heterocyclic amines (HCAs), polycyclic aromatic hydrocarbons (PAHs) and nitrosamines.



Pyridoxine: vitamin B6

Heterocyclic compounds consist of one or more ring structures that contain different elements. In heterocyclic amines (HCAs) one of those elements is (usually) nitrogen. Pyridoxine (vitamin B6) is a HCA so not all HCAs are toxic.

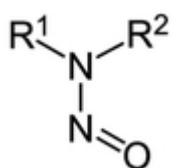
Toxic HCAs are formed from cooking red meat on high temperatures and can also be formed during the smoking of meat. They are created when amino acids, sugars and creatine or creatinine (found in meat) react. ¹ PhIP is one of the most abundant HCAs in cooked meat. HCAs have a concentration that is measured in parts per billion in grilled and BBQ meats.



Naphthalene

Polycyclic aromatic hydrocarbons (PAHs) are compounds consisting of only carbon and hydrogen that consist of multiple aromatic rings. They are produced by the incomplete burning of organic matter. There are several hundred compounds with varied degrees of toxicity. A number of PAHs are found as contaminants of vegetable oils. ²

Naphthalene (found in moth balls) is the simplest PAH consisting of two fused benzene rings.



Nitrosamines are another group of carcinogens that are found in processed

meat, particularly fried bacon. It is formed from sodium nitrate or sodium nitrite that is added as a preservative and prevents the growth of bacteria. They are also found in tobacco smoke.

In October, 2015, 22 scientists from ten countries met at the International Agency for Research on Cancer (IARC) in Lyon, France, to evaluate the carcinogenicity of the consumption of red meat and processed meat. Processed meat includes bacon, ham, hotdogs, sausages, salami, corned beef and canned meats. Processing can include smoking, salting, curing, canning, preserving and fermentation. Sodium nitrate (E250) is used as a preservative.

The majority of the Working Group concluded that there is sufficient evidence in human beings for the carcinogenicity of the consumption of processed meat. It also concluded that there is limited evidence in human beings for the carcinogenicity of the consumption of red meat. ³



In addition to the problems with consuming processed meat, high-

temperature cooking introduces additional dangers. Even the smoke from BBQs or living nearby a restaurant can cause health problems. If you are pregnant, it is advisable to stay clear of BBQ smoke. Airborne products from frying hamburgers, bacon and soybean burgers were tested for mutagenicity (the ability to change DNA). The fumes generated by frying pork and beef were mutagenic but the soy burgers were not.

Well-cooked bacon was 8 times more mutagenic than hamburgers and 350 times more mutagenic than the soy burgers. ⁴

A Polish study showed not only a significant decrease in birth weight associated with barbecued meat consumption in pregnancy but even a greater decrease in birth weight as a result of exposure to airborne PAHs as a result of cooking. ⁵

Cooking meat produces PhIP which is one of the most abundant HCA in cooked meat. This induces cancer of the colon, prostate and mammary glands in rats. PhIP has also been implicated in the initiation and progression of breast cancer in humans. ^{6 7}

A 2011 paper investigated the consumption of red meat as well as cooking methods on prostate cancer. ⁸

Their findings showed that a weekly consumption of:

- 3 or more servings of red meat,
- 1.5 or more servings of processed meat,
- 1 or more servings of grilled red meat,
- 1 or more servings of well done red meat

were **each** associated with an approximately 50% increased risk of developing advanced prostate cancer when compared with men who ate no red meat.

DNA adducts are modifications of the DNA that result from exposure to carcinogens. The level of DNA adducts in normal cells can serve as a marker for a significant exposure to carcinogens. Meat high in PhIP (a HCA) is directly related to PhIP-DNA adduct levels in prostate cells. The following paper suggests that grilled red meat consumption is an important factor in prostate cancer for humans. ⁹

A similar conclusion was reached in regard to breast cancer in the following paper. Consumption of processed meat, fried and stir-fried meat and HCA intake were correlated with the level of DNA adducts in breast tissue. ¹⁰

The popularity of fund-raising BBQs for cancer research is somewhat disturbing given the many damaging effects of consuming BBQed meats.

Footnotes

1. National Cancer Institute (2017) *Chemicals in Meat Cooked at High Temperatures and Cancer Risk* - National Cancer Institute [online]. Available from:

<https://www.cancer.gov/about-cancer/causes-prevention/risk/diet/cooked-meats-fact-sheet> (Accessed 24 April 2018).

2. Pandey, M. K. et al. (2004) Detection of polycyclic aromatic hydrocarbons in commonly consumed edible oils and their likely intake in the Indian population. *Journal of the American Oil Chemists' Society*. 81 (12), 1131-1136.
3. Bouvard, V. et al. (2015) Carcinogenicity of consumption of red and processed meat International Agency for Research on Cancer Monograph Working Group (ed.). *The Lancet Oncology*. 16 (16), 1599-1600.
4. Thiebaut, H. et al. (1995) Airborne mutagens produced by frying beef, pork and a soy-based food. *Food and Chemical Toxicology*. 33 (10), 821-828.
5. Jedrychowski, W. et al. (2012) Impact of barbecued meat consumed in pregnancy on birth outcomes accounting for personal prenatal exposure to airborne polycyclic aromatic hydrocarbons: Birth cohort study in Poland. *Nutrition*. 28 (4), 372-377.
6. Lauber, S. N. & Gooderham, N. J. (2011) The cooked meat-derived mammary carcinogen 2-amino-1-methyl-6-phenylimidazo [4, 5-b] pyridine promotes invasive behaviour of breast cancer cells. *Toxicology*. 279 (1-3), 139-145.
7. Papaioannou, M. D. et al. (2014) The cooked meat-derived mammary carcinogen 2-amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (PhIP) elicits estrogenic-like microRNA responses in breast cancer cells. *Toxicology Letters*. 229 (1), 9-16.
8. John, E. M. et al. (2011) Meat Consumption, Cooking Practices, Meat Mutagens, and Risk of Prostate Cancer. *Nutrition and Cancer*. 63 (4), 525-537.
9. Tang, D. et al. (2007) Grilled Meat Consumption and PhIP-DNA Adducts in Prostate Carcinogenesis. *Cancer Epidemiology Biomarkers & Prevention*. 16 (4), 803-808.
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