RESEARCH ABSTRACT
HUMAN NUTRITION

Title: Assessment of Human Exposure to Heterocyclic Amines (HCAs) from Cooked Meat Products – **NPB# 08-177**

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Scientific Abstract

Heterocyclic amines (HCAs) are produced in meats cooked at high temperature, which are potent mutagens and a risk factor for human cancers. Occurrence of HCAs in ready-to-eat (RTE) meat products and cooked meat products were evaluated. The type of meat products and cooking methods were chosen based on U.S. meat consumer preferences. The primary HCAs detected were 2-amino-3-methyl-imidazo [4,5-*f*]quinoline (IQ), 2-amino-3-methylimidazo [4,5-*f*]quinoxaline (IQx), 2-amino-3,8-dimethylimidazo [4,5-*f*]quinoxaline (MeIQx), and 2-amino-1-methyl-6-phenylimidazo [4,5-*b*]pyridine (PhIP). Overall, the HCA levels in RTE meat products are generally low, but some items may contain elevated amounts of HCAs. RTE meat products were ranked in the following order of increasing total HCA content: pepperoni (0.05 ng/g) < hot dogs and deli meat products (0.5 ng/g) < fully cooked bacon (1.1 ng/) < rotisserie chicken meat (1.9 ng/g) < rotisserie chicken skin (16.3 ng/g).

The HCA content in cooked meat depends on the type of meat, cooking methods, and cooking temperature. Total amount of HCAs can be used to order these cooked meat products from low to high. Low levels of total HCAs (less than 5 ng/g) were found in baked beef (2.34 ng/g), fried chicken thigh with skin (2.33 ng/g), medium-rare fried beef (2.73 ng/g), fried chicken breast with skin (3.13 ng/g), baked pork (3.29 ng/g), and fried pork patty (4.12 ng/g). Intermediate levels of total HCAs (5 to 10 ng/g) were found in fried beef patty (5.46 ng/g), fried chicken thigh (5.58 ng/g), well-done broiled beef (6.04 ng/g), fried chicken breast without skin (7.06 ng/g), baked fish (8.32 ng/g), and well-done fried beef (8.92 ng/g). High levels of total HCAs (higher than 10 ng/g) were found in fried pork (13.91 ng/g), fried fish (14.91 ng/g), and fried bacon (17.91 ng/g).

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Because of the increasing evidence of the risk of cancers, it is desirable to reduce the exposure to HCAs. Although, it is impossible to prevent HCA formation completely, a reduction of the HCA levels in cooked meat and fish can be achieved by several methods. The addition of salt and phosphate greatly improved the water-holding capacity and decreased HCA formation (up to 58%) in enhanced fresh meat products. However, enhancement with water alone did not reduce HCA formation because the meat did not retain the injected water. A greater reduction of HCAs (up to 79%) was found in marinated fresh meat where the enhancement solution contained ingredients rich in antioxidant compounds.

Taken together, the results from this study can be used to recommend cooking methods for use at home or in the food industry, or used as guidelines for the meat industry on how to modify a formulation process to minimize HCA formation. These data provide information for use in estimating HCA exposure and will facilitate investigation of the role of HCAs in the etiology of cancer in the United States.